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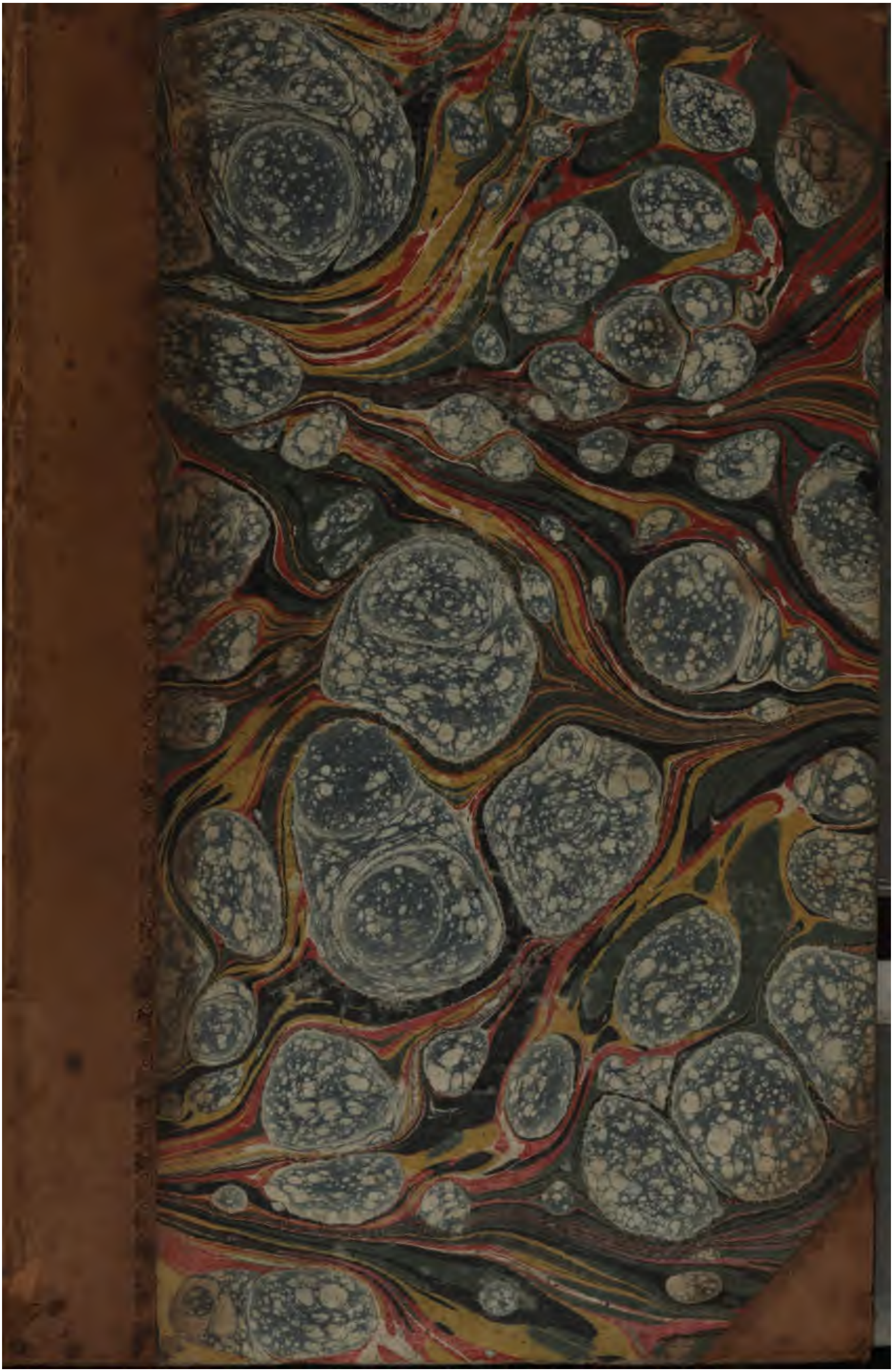

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GILL'S

TECHNOLOGICAL REPOSITORY;

OR,

DISCOVERIES AND IMPROVEMENTS

IN THE

Useful Arts,

BEING A CONTINUATION OF HIS TECHNICAL REPOSITORY.

By THOMAS GILL, *Patent-Agent,*
AND DEMONSTRATOR IN TECHNOLOGY, ON THE APPLICATION OF
SCIENCE TO THE USEFUL ARTS AND MANUFACTURES;
UPWARDS OF TWENTY YEARS A CHAIRMAN OF THE COMMITTEE OF MECHANICS IN THE
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BIBLIOTHECA·BODLEIANA

GILL'S
TECHNOLOGICAL REPOSITORY.

I.—*On the French Manufacture of Enamelled Watch Dials*[*].

THESE are formed of thin plates of copper, on both sides of which the enamel is applied, and afterwards the hours, minutes, &c., are painted upon them, also in enamel. The following is the process employed. After having prepared a thin plate of copper, of a convenient size, they form it to shape with a hammer, the face of which is slightly rounded, supporting it at the same time upon a block of wood made a little concave upon its surface; the plate is thus easily made into form. A hole is made in its centre, which is afterwards enlarged with a round taper broach, to the size of the hole in the watch-plate; but we must take care to insert the broach on the concave side of the dial, in order that it may form a bur, or border around the hole above, which serves to retain the enamel in its place. We place the dial upon the watch-plate, and pass the broach through the holes in them both at once, in order to form the hole at right-angles with the plate, holding it firm with plyers; and we likewise pierce through the dial the holes for the studs, which holes are also previously formed in the watch-plate; we likewise make the hole for the watch-key to enter; and we form a border around this hole in a similar manner to that around the central hole, and for the same purpose, of retaining the enamel around the hole.

We next fit on the feet or studs of the dial: in order to this, we take copper, drawn into wire of a proper size, and with a file form a pivot at the end of it, in size agreeing with the hole pierced through the watch-plate, and we rivet it by strokes with a hammer, and then cut it to a length sufficient to allow the dial to be placed at the distance of a line or more from the watch-plate. We then adjust the other feet in a similar manner, and lastly solder them with hard solder. We cut, with small shears, the dial around the watch-plate, laid underneath it in such a manner as to leave a small portion projecting beyond the watch-plate, and, with a round burnisher, raise a small border around the edge of the dial, on its convex side, in order to retain the enamel in its bounds. This done, we clean the plate from oxide, by leaving it in water slightly acidulated with nitric acid, until the copper is become bright all over. It must then be rubbed with a wire scratch-brush and water. This last operation disposes the pores in the copper to receive the enamel, and to retain it firmly after its fusion.

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[*] From the *Dictionnaire Technologique*.

The enamel used for watch-dials is very white; and it is sold in the form of small loaves. In order to use it, these loaves are broken into morsels, and are then pounded in a mortar of hardened and tempered steel, but not so much as to reduce it into powder; it is sufficient to reduce it to the size of grains of sand, and as nearly as possible of an equal size. These are afterwards washed in a vessel of glass, with pure water, and stirred with a spatula, until the whole forms one white mixture; it is then left to settle, and the water is decanted. It is then repeatedly washed in several waters, until it becomes perfectly clean; they preserve those parts of the enamel which subside from the washing waters, in order to employ them for the *counter-enamel,* of which we shall speak presently.

When the enamel has been well washed, it is suffered to remain in the glass vessel, and they pour over it nitric acid, until it covers it to a trifling depth. They stir it from time to time with a glass spatula, and suffer the acid to act upon it for twelve hours. This operation is intended to remove any metallic parts from the enamel which may have been detached from the mortar during the action of grinding, and which would discolour the enamel on fusing it.

At the end of the twelve hours the nitric acid is poured off, and the enamel is washed with common water, until it no longer contains any acid: lastly, it is covered with pure water, and preserved in that state for use.

They not only enamel the dials on their convex side, or that on which is to be painted in enamel the hours, &c.; but they likewise enamel the concave side, which they term *counter-enamelling*. The counter-enamel is necessary, to prevent the enamel on the face of the dial, when fused, aided by the action of the heat, from changing the curvature given to it. In order to avoid this inconvenience, both sides are covered with enamel, and fused at the same time.

They commence with the counter-enamel, and employ for this purpose the residue of the washings, as above-mentioned; they place the dial-plate upon the broach, which is introduced into the hole in its centre, the concave side being uppermost. Then, after pouring off the water which floated above the counter-enamel deposited at the bottom of the vessel, they take it up with a steel spatula, and spread it equally all over the concave surface of the intended dial, so that it may cover all the copper. They then remove the broach, and apply a piece of fine linen to the enamel, which attracts and takes up the water in it. Without taking this precaution, on turning the dial, the counter-enamel would fall off.

To place the enamel on the convex surface of the dial, they replace the broach in the central hole, and charge the upper face of it with an equal layer of pure enamel, taking care that it well covers the borders of the dial, and the holes in it, so that the heat may not burn them. In order to remove the water which is contained in the enamel, they place a linen cloth on the border of the dial; the linen attracts the humidity, and thus all the parts of the enamel are well arranged, and contained in the least possible space; they then strike with the handle of the broach slight blows, in order to level anew the enamel, and then again extract the water as before. This operation the enamellers term beating the enamel. Upon this being well performed, the beauty, and the polish, or glossiness of the dial depends; so that the enamel, when fused, may not contain ady cavities beneath its surface, but be perfectly united. In order to be certain that no water remains in the enamel, it is suffered to dry upon an iron plate, pierced full of holes, with three of its edges turned up, and laid upon live coals.

These preliminaries being fulfilled, the dial is placed in a reverberatory furnace, under a muffle, but it is very slowly introduced, in order to heat it gradually. It is suffered to remain at rest in the furnace, until the enamel is seen to commence entering into fusion; it is then gently turned round upon the iron plate, and again left at rest, in order that the heat, if unequal, may strike equally at one time or another upon all parts of the dial. When the enamel is melted, which is easily known by the polish upon its surface, it is withdrawn from the fire with care, and suffered to remain at the mouth of the furnace, in order that the enamel may lose its heat by insensible degrees; otherwise, in passing from a high temperature into a cold atmosphere, the enamel would crack and fly off.

After having thus passed the dial through a first fire, it is again placed in a weak nitric acid, and afterwards washed perfectly. The counter-enamel is then applied to those parts which remain uncovered, and a second layer of enamel, as white and pure as the first, is laid upon the face of the dial, with the same precautions as before. It is then again placed in the fire; and the operation is even repeated a third time, to give the surface of the dial its greatest beauty of polish.

If it should happen that the enamel contains any air-bubbles or blisters, these must be opened with the point of a graver, be filled with fine enamel, and the dial be again passed through the furnace; and this operation must be repeated until its surface is become uniformly polished.

The dial is now ready for painting. The hours, &c., are painted in a soft black enamel prepared on purpose, and which is called ***noir d'ecaille***. This is ground very fine in an agate mortar, with a pestle formed of the same substance, and mixed with oil of spike lavender. It must be reduced to an impalpable powder; a day and a half is scarcely sufficient to grind a *gros* of it. We dilute this black for painting, with more oil of spike, and employ it to paint the hours, the divisions for the minutes, &c.

We would recommend that a mark be made on the edge of the dial, to indicate the place of number twelve, with a file. The dial is then to be divided upon a platform, and the divisions be slightly traced from its centre with a black lead pencil, by the help of a division plate and its index; but previously, and with compasses, one point of which is furnished with a cone, and the other carries a port-crayon with a black lead pencil in it, we must trace the circular lines which contain within them the divisions of the hours, minutes, &c. When the painting is become perfectly dry, the dial must be fired for the last time in the manner above described, and with the same precautions.

II.—*On the Arts of Painting and Working in Enamel*[*].

WITH A PLATE.

In our last number we gave a description of the manner of preparing enamel colours. We have given in the preceding article the French manner of making enamelled watch-dials; and we shall divide the remaining methods of employing them into three distinct branches, viz. the art of painting in enamel, the method of using the clear and transparent enamels, and the method of working enamel by the flame of the lamp.

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[*] From the *Dictionnaire Technologique*.

1. *On the Art of Painting in Enamel.*—We shall not attempt to give the history of the art of painting in enamel, as it may be found in several works treating on this subject. The art of enamelling upon earthenware is very ancient, but this is not the case with the method of painting in enamel upon metal, which cannot be traced beyond the reign of Francis the First.

Enamelling is performed either upon gold or copper. Some authors have indeed pretended, that there are painters of enamel upon silver, but we much doubt it. From the many attempts which we have ourselves made, we are convinced of the great difficulties which attend the practice. The silver is subject to swell, and cause blisters in the enamel, and thus form *eyes,* or holes in it. All our enamel painters employ gold and copper.

The goldsmiths prepare the plates for the painters in enamel. Their width and breadth vary according to the uses to which they are destined. The gold ought to be of twenty-two carats fine, or rather more; but if too fine it has not a proper consistence; and if not fine enough, it is liable to melt. They make an alloy, one-half of which they say is white, and the other half red; properly speaking, it is composed of one half silver, and one-half copper; the enamel which covers the metal is thus less liable to become tinged of a green colour, than when the alloy is made with copper alone.

The workman forms around the edges of the plate a small ridge, or border. This ridge or border serves to retain the enamel, and prevent it from falling off, in applying it, by means of a spatula. The height of the border must agree with the intended thickness of the coat of enamel; but as this varies according to the nature of the work, so must the height of the border correspond therewith. We must however here remark, that when the plate is not intended to bear a counter-enamel, or a coat of enamel applied to its back, it must be less charged or loaded with enamel; as the enamel, when in the fire, draws the gold towards itself, and causes the plate to become convex.

When the enamel is not intended to cover the whole surface of the plate, it is necessary to form a lodgment for it. With this intent, the outlines of the design must first be drawn upon the plate with a black lead pencil, and then be traced with a graver. The spaces inclosed within the outlines of the design must then be deepened by proper tools, equal to the height which would have been given by the ridge or border, had the plate been intended to have been enamelled all over. This deepening is effected with a flat graver; and to have it everywhere of an equal depth, requires a care, which must not be neglected. If we leave any eminences or raised parts, the enamel falls away, and becomes too thin over those places, and the green colour appears through it. The bottom of the lodgments for the enamel must have slight hatchings or teeth formed upon it, crossing in all directions; some persons effect these with rifflers, made with the ends of files, broken square across. These hatchings or teeth afford a hold to the enamel, which, without this precaution, would separate from the plate.

After this operation, the plate must be thoroughly cleaned from all greasiness, by boiling it in a strong alcaline ley; it must then be washed with water acidulated by a little vinegar, and lastly in pure water.

The plate, thus prepared, is next to be covered with a coat of white enamel laid upon it wetted with water, much in the same manner as in the enamelling of watch-dials*, only here there are no holes made through the plates; nevertheless, there is a little address necessary to be employed in bringing the enamel into contact with the ridges or borders; and for this purpose also a particular kind of tongs are employed, which are termed *releve-moustache,* and are shown in plate I. fig. 2. The enamel is spread with a spatula, the figure of which is shown in plan at *a*, in fig. 3, and sideways at *b*. To keep the enamel in its due bounds, we strike the edges or borders of the plate with the spatula.

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* See the preceding article.

When the enamel is nearly dry, the plate is laid upon a piece of sheet iron, pierced with small holes, shown in fig. 2, and placed upon hot ashes, where it remains until it no longer gives off any vapour; and indeed it may remain there until the moment when it is to be put into the fire in the furnace, as if it were suffered to become cold it must again be heated by degrees, previous to placing it in the furnace, as otherwise it would cause the enamel to crackle or fly off the plate.

Having thus shown the manner of placing the plate, covered with loose enamel, in the furnace, it becomes necessary to make known the construction of this furnace, which is distinguished in chemical laboratories by the name of the assay-furnace without a grate.

This furnace is square; fig. 4 is a front elevation of it. It is formed in two parts, the lower part, A, is the body of the furnace, and the upper part, B, its head; and which fits upon the lower part, as shown in fig. 5, which represents those two parts as separated. This furnace is formed of a proper refractory earthenware, or material, and the scale below it gives its proportions.

The head has an opening or door in it, which is to be closed or shut, with a stopper *m*, also formed of earthenware, in order to give activity to the combustion. This door is to be opened, in order to introduce the charcoal during the operation.

The furnace has also another door, D, which descends to the projecting plate E, which is termed *mentonniere*, and which is seen projecting at E, in fig. 5. This plate is supported upon and strengthened by the two brackets F F, the whole being formed in baked clay. The height of this door is lessened by a kind of brick of baked earth G, which not only covers the whole of the projecting plate E, but also enters the opening in the door D, of which it fills the width, and slides upon the floor of the furnace; this part is termed the hearth of the furnace, and the use of it will be shown presently; it can be removed and replaced at pleasure, by means of a kind of handle formed upon its front.

The form of the hearth is shown at fig. 8, which is a plan of it.

We perceive below the projecting plate E a square hole H, which serves two purposes; first, for the introduction of the air necessary to support combustion; and secondly, to remove the ashes, which must not be suffered to accumulate. There are similar holes also made on each lateral face of the furnace, as is seen at H H H, in the plan, fig. 7.

At the height of and on a level with the projecting plate E, within the furnace, is placed a plate of baked earth, pierced with several holes, of five or six lines in diameter, to admit the air necessary for the combustion. This substitute for the grate is shown in plan, at fig. 7.

Figs. 8, 9, and 10 represent, in three different positions, the muffle, the use of which we shall show presently. Fig. 8 is an elevation of its interior, fig. 9 an external side view of it, and fig. 10 an elevation of its front end. We see, in fig. 5, the muffle placed in the furnace; it rests upon two bars of iron, or still better of baked earth, which are supported upon brackets, made upon the lateral walls of the furnace. The muffle is also made of baked earth, and should be as thin as possible.

The whole being properly constructed, we may proceed to charge the furnace: we first take charcoal, either made of the branches of beech, or in want of that of oak of about an inch in diameter, and each cut to the length of the furnace, and lay it near its mouth; we chuse those branches which are the straightest in preference, in order that there may be less instertices between them. We arrange these one alongside the other upon the perforated plate serving for the grate of the furnace, so that they touch; we then place over them in a similar manner another layer, and again a third, so that each piece of charcoal in the third layer is borne upon two of the second; and each one of the second upon two of the first layer. One end of each piece touches the back of the furnace, and its other end corresponds to the mouth of it. We adopt this disposition, in order that if one of the coals is consumed too quickly, it may be substituted by another.

This done, we next place the muffle on the beds of charcoal, with its opening towards the mouth of the furnace, and as close to the mouth as possible. And we also place it with its upper surface exactly on a level with the interior surface of the mouth.

We likewise line the sides and back of the muffle with the same kind of charcoal. Those pieces on the sides are arranged in the same manner as those of the three layers, and we place across others, which are laid at the back of the muffle. Both of them are raised to the height of the muffle, and then we again arrange them longitudinally, and parallel to those of the former beds. We place one layer above the muffle.

When this last layer is made, we take small charcoal of the same kind, and spread it over the top of the other coals, to the height of four inches. We then cover the furnace with its head; and we spread over the bottom of the muffle four or five pieces of charcoal, so as partly to fill up the inside of the muffle; lastly, we throw in, at the mouth of the furnace, the lighted charcoal, which is intended to kindle that we have before charged the furnace with. Having then finished the filling of the muffle with more charcoal, we shut the door of the furnace, and leave it to become well heated. When we are obliged to revive the fire, we blow into the muffle with bellows.

When the colour of the muffle appears of a high red, it is time to place the piece to be enamelled in the fire; for this purpose it is necessary to clear the bottom of the muffle from the charcoal in it, and to throw it into the furnace through the hole in its head. We then take up the pierced iron plate, with the piece to be enamelled lying upon it, by means of the tongs, fig 2, and place it within the muffle as far back as possible. But if it has become cold, it must not be put immediately into the muffle, but together with the pierced iron plate be laid before the muffle to heat it, and be carried by degrees to the bottom or farther end. After this, the mouth of the muffle must be partly closed by two pieces of charcoal only, in order that we may see between them what passes in the muffle. We then conduct the operation of firing the piece, in the manner already described in the preceding article on making enamelled watch-dials.

The plate covered with enamel, however white, will yet require to be ground smooth, especially if it be a flat one. For this purpose we employ the grit-stone, used by shoemakers in sharpening their cutting knives, shown at fig. 14, and wet it with water; and we rub it all over the surface of the enamel, together with a little finely powdered or sifted sand produced from freestone. When all the undulations with which it was covered are effaced, we obliterate the marks of the sand with water and the stone alone. This done, we wash and brush it well with plenty of water. We then repair any defects in its surface, such as holes, blisters, &c., in a similar manner to that described in the preceding article, and we shall then obtain a plate with its surface perfectly plain and equal; it is now fit for painting upon.

Formerly this process was attended with the greatest difficulties; but now, since chemistry has made such progress, it is easy to make the enamel colours exceedingly solid, and so that they shall all fuse at the same degree of temperature; so that painting in enamel is not attended with greater difficulties than oil-painting: it is sufficient to be well acquainted with the nature of the colours, their preparation, and the effect which each produces when passed through the fire.

The enamel painter prepares his colours by grinding them in an agate mortar, such as is shown in fig 12, with an agate pestle, shown in fig. 13. They are ground with the purest essential oil of lavender, which has been previously rendered *fat*. They are next ground upon a small slab of rock-crystal or agate, with a muller of either of those materials, until they become as smooth as though oil alone was ground. They are then to be be placed on a palette, as if for miniature painting.

The manner of rendering the oil of lavender *fat* is very simple; it is put into a glass vessel with a broad bottom, to the depth of an inch, covered with a piece of gauze, and then exposed to the sun-shine, until on inclining the vessel it is found to have lost its fluidity, and has become of the thickness of olive oil. The time necessary to render it fat is more or less long according to the season.

The painter should always have on one side of him a stove, with a soft and moderate fire of wood ashes in it. Whilst at work, he must expose his piece, laid upon a perforated iron plate, from time to time to the heat, and let it dry.

When the painting is finished, it is placed in the fire in the muffle furnace before described, filled with fuel in a similar manner, and treated with the same precautions. It must be withdrawn the instant the painting is fused, which is known by the polish acquired all over the surface of the picture. Before, however, it is finally removed, it must be suffered to cool by slow degrees.

After this first burning, the artist repairs what the fire has injured; he employs the same processes already described, and passes the piece through a second fire. He is obliged, in fact, to give it even five firings, but he need not exceed this number unless his colours are refractory. The same processes are likewise employed in painting upon porcelain, stone-ware, &c.

2. *On the Art of using clear and transparent Enamel.*—Gold is the only metal which can be employed with advantage in the use of this enamel. We commence by tracing the outlines of the design upon the plate; then removing the surface to a proper depth with a flat graver, and other proper tools; we give to the bottoms of the lodgments a burnished polish*, without doing which we should see through the enamel the coarse marks of the tools. After this operation, we paint in enamel colours, in bass relief, on the bottoms of the recesses, all the figures in such a manner that their highest point of elevation shall, nevertheless, be lower than around the borders of the recesses. The reason of this is evident, because on the different distances from the bottoms of the recesses to the surface of the plate depend the lights and shades produced by the various thicknesses of the enamel. A skilful painter will soon perceive the necessity of grouping his figures according to the nature of the work he is employed upon.

When the painting is dry, the transparent enamel must be placed in the recesses, in the same way we have before described in laying on the white enamel; but the coloured enamels must not be ground too fine, but only reduced into grains, so as to appear gravelly under the touch of the fingers. The larger we can employ them, the more beautiful are their colours.

We must pass the plate through the furnace with the same precautions we have before indicated in employing white enamel. Two firings are generally sufficient. We also smoothen the surface of the enamel with a whetstone, when this operation becomes necessary.

3. *On the Art of working Enamel by the Lamp.*—The art of working enamel by the lamp is one of the most agreeable and amusing that we know of. It has only one object, which is, to execute works in enamel by means of

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* In this country, these are frequently ornamented by *engine-turning*.—Editor.

the flame of the lamp speedily, and in a more or less perfect manner, according to the greater or lesser skill in working the enamel, and a knowledge more or less perfect in the art of modelling. To excel in this kind of work, we must possess a knowledge of design, and must practise for a long time the modelling of all kinds of objects and figures.

To work with the lamp, we must first procure an assortment of tubes and rods of glass and of enamel, of all sizes and colours.

We shall also want an enameller's table, svch as is represented in fig. 15, and upon around which may be placed several lamps and workmen; and underneath which are posited the large double bellows D, which one of the workmen actuates with his foot, in order to revive and extend the flames of the lamps, which, being lengthened by means of the blast, and contracted into an exceedingly narrow point relatively to that which they ordinarily occupy, thus acquire a heat and vivacity inconceivable.

Below the table, and in its thickness, are made grooves, which are covered with parchment, and serve to conduct the blast to glass tubes placed opposite to each lamp. These tubes, AAAA, which are termed *porte-vent*, or blow-pipes, are formed of glass, and are curved at their upper ends, so as to direct the wind into the middle of the flames of the lamps. The holes in them are very small; they serve both to increase the force of the flame, and to contract it also to a point; and they may occasionally be turned away from the flames, when not required for use. In fig. 16 is shown a perspective view of an enameller's lamp, A; this is placed in its support, B; C is the blow-pipe, which is pointed obliquely towards the flame. The blow-pipe is adjusted by being held in a perforated cork D, which exactly fills and closes the hole in the table, into which it must be put. When only one person is at work at a table where there are several lamps, he places himself at that lamp which is close to the pedal of the bellows; he then removes all the other blow-pipes, and closes the holes with corks.

The lamps may either be made of copper or tinned iron plate; the wick is composed of coarse cotton threads, and the oil burned in France is rape-oil.

In order that the workman may not be incommoded by the heat of the lamp, he places between it and himself a square block of wood, on which is placed a tin plate or fan. The block is steadied by means of a stem, which fits into a hole made in the table; and the plate casts its shadow upon the face of the workman.

The workshop of the enameller is darkened, so that daylight is shut out; were it not so, the natural light would be partly eclipsed by the light of the lamp, and the workman could not see distinctly enough to perform his work with certainty.

It is quite impossible to describe all the manipulations in this description of work; but above all, a knowledge of taste and design must prevail. As an example, we may suppose it is desired to form a swan. The enameller takes a tube of white enamel, closes one end of it hermetically with the flame of the lamp, and when it has become sufficiently heated, he blows it into a kind of bottle, to which he gives the shape of the body of the bird; he then lengthens and bends the neck, forms the head, the beak, and the tail; after which, with a solid rod of enamel, and of a proper colour, he makes the eyes; he lastly opens the beak, forms the wings and feet, and the swan is finished.

This art is applicable to an infinite variety of works. For several years a Dutchman, named Dumesnil, worked in public at Paris, with an astonishing skill. He made before the numerous spectators who crowded around him all the articles they required. And now M. Bunten, one of the most skilful opticians in that metropolis, executes either in glass or in enamel all sorts of pleasing objects with great dexterity and delicacy.

The enameller spins aigrettes with great facility. He takes a slip of plate glass, and makes it red-hot; he then draws it out into a thread with pincers, and carries it to a reel, to which, when it is affixed, he gives a great velocity, and in a little time it becomes covered with a skein of glass of an inconceivable degree of fineness; we may say, that he nearly performs the operation in the time we take in describing it.

The enameller also makes artificial eyes. There are artists in Paris who so nearly imitate the colours of the natural eye, that it is difficult to perceive that a person who wears an artificial eye has been deprived of one of his eyes.

When the enameller works, he seats himself at his table, his foot upon the pedal of the bellows, and holds in his left hand the work which he would execute in enamel, or the iron or brass wires which serve to support the figure; he then conducts with his right hand the thread of enamel, softened by the flame of the lamp, and thus forms his works with a dexterity and patience truly admirable.

It is difficult to make large pieces by the lamp; we have not seen any which exceed four, five, or six inches in size. L.

III.—*On an improved Rain-Gauge, or Meter, invented by Mr.* SAMUEL CROSLEY, *Engineer, London.*

WITH A FIGURE.

IN the last number of the "Philosophical Magazine and Annals of Philosophy" we find a description, by Mr. John Taylor, of a rain-gauge or meter, founded upon the principle of Mr. Crosley's gas-meter, and who was not, probably, aware that Mr. Crosley had already applied his gas-meter to the purpose of measuring liquids.

Mr. Crosley has, however, also invented another meter for liquids, and which is, of course, equally adapted to form a rain-gauge of a much simpler construction than that of the gas-meter. He has kindly permitted us to give a description of this ingenious contrivance.

In plate I., fig. 1 is a section of the instrument; A is a metal vessel or receptacle, having a slit across and through the middle of its upper part, into which the spout of a funnel, B, of a sufficient area, or spread above, to receive the rain, is made to enter, and be firmly affixed to the receptacle; C is a vibrating trough, turning upon pivots or knife-edges, and having a division in its centre. The vibrating trough rests or lodges upon one or other of the supports, D D, affixed on each side of the receptacle, until a sufficient quantity of rain has fallen into its higher part, to cause it to preponderate, and assume the position shown by the dotted lines, and rest upon the opposite support D. The rain will then fall into the other side of the vibrating trough now uppermost, until it has in a similar manner filled that side sufficiently to overbalance it, when it will in its turn also change its position, and rest upon the former support D, as at first; and so on whilst the rain continues to fall.

It is very easy to cause the vibratory action to move a train of wheel-work and indexes, to record upon a dial-plate the quantity of rain fallen for any required time, by merely adding a lever to the axis of the vibrating trough, which shall act upon the wheel-work at each vibration; E is a spout, to suffer the water to pass out of the receptacle.

The great simplicity of this apparatus constitutes its chief merit. We should add, that both these meters of liquids form the subject of a patent, taken out by Mr. Crosley several years since.

IV.—*On the Management of Bees, and raising Stocks of them. By Mrs.* M. CLIFTON, *Mr.* GEORGE HUBBARD, *and Mr.* THOMAS MORRIS.

(*Concluded from Vol. I. p.* 383.)

THIS summer many complain of having what they call bad luck with their bees, and say honey will be scarce;

but, thank God, out of seventy-six or seventy-seven hives, I have had as follows:—

	lbs.
Glasses and small hives filled, thirty-one, weighing - - -	153
Virgin honey - - - - - - - - - - - -	160
Stock or common honey - - - - - - - - - -	125
	438

This I call a good year, though some have been better. I have also furnished many gentlemen's and ladies' apiaries with bees, and have now thirty-seven good stocks for next season, besides an increase of sixteen stocks, and the honey above mentioned. My bees are, for the most part, well situated for collecting honey, and also for swarming, viz. in the parishes of Isleworth and Twickenham, in Middlesex.

I never intend to prevent my bees from swarming, but leave them at liberty to swarm, or not to swarm. Those stocks, the mothers of which do not breed so fast as others, of course cannot swarm so early; therefore I put on them glassess, or small hives: if the stocks so glassed keep working without swarming, you most likely will get sixteen or seventeen pounds of honey in a month's time, and save all the bees alive; and such a stock will, except by accident, make a good stock next season.

My hives, made as before described, have a board at the top, seventeen inches wide, this is a full inch wider than the outside of the hive, that one may stand on another; and thus you may make complete colonies of bees with a small expense, for three hives make a complete colony. When hives are made in this manner they cost but 12*s*., but in octagon boxes 1*l*. 10*s*.

I much prefer straw hives, well made, to wooden ones, because the joints of the wood often give way, by being exposed to the weather and the sweat of the bees; and the moth-fly (the greatest enemy they have) gets in and lays her eggs in the comb, and the warmth of the bees hatches them to their own destruction; therefore straw hives are preferable, as well as cheaper than wood.

My method of managing straw hives is thus: when I make use of an old straw hive, I dip it into a copper of boiling water, so that if there should be any moth's eggs they must be destroyed; but I let the hive be perfectly dry before I use it.

Hives should be well made, and closely sewed together, but many are sold not worth using.

The best situation for the houses is a little to the west of the south; for the sun shining into the mouth of the hive too early, calls the bees abroad before the cold steam is exhaled from the flowers, and the vernal juice turned into honey: but in this situation the sun will reach the front of your bee-house about nine o'clock. I would have the front of the house leaning a little inwards, that the mouth of the hive may fit close to the mouth made in the boards, which should be three inches long in summer, and one in winter, and about one fourth of an inch high, the better to keep out cold and the bevering moth, which you may often see, at the latter end of August (when the working of the bees begins to decline), standing at the mouth of the hive, bevering their wings as if just flying in among the bees: they there lay their eggs, and with the wind of their wings fan them within the hive; and the warmth of the bees hatches them, to their own ruin. In October every stock should be well examined, and all the maggots brushed out, to prevent danger; for the grub or maggot forms a chrysalis, with a covering so strong, that the bees cannot displace them; and in the spring they creep out of their little sepulchres, and spin a thin web before them, as they march up into the hive among the combs; and the bees endeavouring to dislodge them, are entangled in the web, and there die: and thus for want of a little trouble, many stocks are destroyed.

To cleanse the hive of these maggots, it must be turned up, and the dust and vermin picked out, and then gently set down in its place. If your bees are well, and in a condition to stand the winter, and have a mother with them, they will sting, otherwise not unless you hurt them: however, a yard and a half of Scotch gauze sewed round the brim of your hat, and then tied round the waist, having holes for your arms, will completely secure your face.

The hive should be also brushed on the outside very clean, and washed all over with a sponge dipped in brine made with clean salt; a small quantity of lime and hair, made fine, should be put round the bottom, and the hives be covered with hay or haybands; for straw may contain some corn which may attract the mice, who may gnaw the hives.

I have mentioned how the front of the house should be formed, by setting the front board, which the mouth of the hive stands against, on the inside; but let the roof be made so as to keep the entrance dry, for a foot before the mouth: the back shutter, folding doors, and ends of the roof, should be made very close, to prevent any vermin entering the house: the first floor, or bottom of the house, should be about two feet and a half from the ground, in such places as gardens or orchards; but, on the side of a hill, or where the bees have no obstruction from hedges, &c., it may be but eighteen inches. As bee-houses cannot be very expensive, I would have a house made but for four hives, the second floor two feet from the bottom, and the roof two feet from the second floor; but the second floor may be made moveable, in case you wish to form your bees into a colony, and then you will want the whole depth of your house.

I confine them to four stocks in a house, because I find, when they are too close, they are apt to rob one another; but when there are but four stocks in a house, I have observed one turn out to the right and the other to the left.

If more than one house be required, they should be placed ten or twelve yards distant, which may be done by driving a strong stump into the ground, and placing on it a piece of elm or oak plank, two or three inches thick. The hives must never be covered with rags, for they are apt to breed moths; the upper and lower floors should be two or three inches thick.

I come now to my method of feeding them, which, I think, is new. Sink a cavity in the middle of the floor, about six inches diameter, like a trencher, deep enough to hold a quarter of a pint of honey, and no more; if the cavity be too deep, the bees may be suffocated. A channel must be made from the outside of the floor, to communicate with the cavity; and a piece of wood to fit close into it, to keep out the vermin.

If your bees do not weigh sixteen or seventeen pounds, exclusive of the hive, they must be fed in September, October, March, and April, and sometimes in May; they must not be fed in cold weather, for that calls them from sleep, and they then never return to the hive again: nor must they be fed in the sunshine; for when the honey smells strong, it sets them quarrelling and fretting, and the strong injure the weak. The best time is evening, when I take the piece of wood out of the channel, and gently pour a quarter of a pint of honey into the cavity: if the honey will not run freely, I boil up four or five pounds with a quart of strong sweet wort, which brings it to a proper liquid. This food will be of great service to the mothers, and make them lay eggs in abundance in the spring.

If a stock has been glassed two summers, it should not be worked a third: but if it increase, take a new hive, or a clean old one, and take off all the covers from the top of the hive: let it be stuck the same as if you was to have a new swarm; place it on one of the floors; and having opened the hole on the top nearest the back, place a piece of lath diagonally from that hole to the side of the mouth; let it be made fast with pegs, not nails, lest the honey be stained; then place the old hive upon the new one, and stop the old mouth close; and the bees will then gradually work down the new hive: that will give them sufficient room for the summer. And next spring take another clean hive, and place the two upon it, in the same manner as before: this will serve for the next year. Now having had no honey for two years, the upper hive will most likely be full, and may be taken away as follows:

With a strong chisel separate the top hive from the other two; and in a fine day take it away, twenty or thirty yards, and place it on the ground bottom upwards; and secure the holes on the top of the second hive.

The bees no doubt will rage; but you must secure yourself with gauze, as before directed, and wear black stockings, for that colour is least observed. Place a table even with the mouth of the lowest hive, and spread a cloth over it, near the mouth, and by this time the greater part of the bees that were out will have come home: the middle hive being the breeding-place, it is most likely the mother is in that; but if she was in the top, she may yet be safe. Place a clean hive, of the same diameter as that you have taken away, upon it; then tie a cloth over both (glasses and all, if there be any), so tight that the bees within may be in darkness: let them remain thus half an hour; then, with a stick, tap the bottom hive, but not so hard as to injure the combs; continue tapping half an hour; then untie the cloth, and take away the upper hive, into which the noise has driven the bees, and place it on the table and cloth from whence you took them, and shake them out on the cloth, and they will run into the mouth of their proper hive. If necessary, repeat this operation, and all the bees will be saved; this saves the trouble and loss of smothering them with sulphur, as was the custom; and the bees, in one day, will forget the injury, and work as usual. But in case but little honey is left in their two hives, they must be fed; thus, in two hours, your honey may be taken, and the bees preserved: the honey you have obtained in this way may be dark, but will make excellent mead; but better and brighter will be produced by those which work in glasses.

Hives will not be beneficial in barren countries; but should be near gardens, shrubberies, orchards of cherries, or farms where clover, beans, saintfoin, or French wheat, grow. Lime-trees, or green-house plants, set out in the spring, orange or lemon trees, are useful, and produce excellent honey; where there is room, it is worth while to plant gooseberries, currants, sweet majoram, peppermint, or the like.

Though I am not for preventing bees from swarming whenever they are inclined, yet I acknowledge that it is sometimes necessary to destroy some stocks.

If they have lost their mother, and neither swarm nor work much, they should not be kept.

The moth, or other accident, will sometimes spoil them, and then they should be destroyed.

My neighbours say, that when I die the bees will lose the most compassionate master in this kingdom. Indeed I have destroyed none but from necessity, and have been for near twenty-four years remarkably successful.

I have now forty stocks in good condition, though the loss of mothers, or some unforeseen accident, may happen to some before summer.

The loss of a mother may be known, by the bees ceasing to work, and mourning incessantly; they will sometimes in that case leave their hive, and try to force themselves into one that is near.

This circumstance should be noticed; for the old hive may be well stored, and when they have left it as a residence, they will yet return with their companions, and carry away the honey; some, for want of observing this, have wondered how a heavy hive, that has been left, has become light.

But though the mother be lost, if there be eggs they will sometimes stay and hatch them; and if any royal seed be among the eggs, they may survive, and become a good stock; but this is not often the case.

About a month ago I was desired to look at five stocks at Richmond, in order to purchase them; one of the heaviest was without a mother. I purchased that, and one more, where the mother was lost; I found twelve pounds of honey, but no eggs, and therefore the bees would not have staid long: the other three were old, and the honey black, and therefore of no use but to stand and swarm another year.

If bees continue in one hive for four or five years, they always degenerate, and become both fewer and weaker: the reason is, the combs for breeding are generally made on purpose, and larger than the rest: every time a bee is hatched in one, a skin or coat is left behind which reduces the size; and in time it becomes too small to produce a bee of its proper dimensions, and occasions a necessity for their having frequently new habitations, which they will always accept, if you provide them a good situation and clean hives.

My situation is a good one, by accident, or otherwise; for I could not have afforded to have made it so by planting.

In the parish of Isleworth, twenty-four years ago, there were not ten stocks of bees; and now, through the approbation of my management, there are more than two hundred.

I hope what has been thus simply stated may be worthy your attention, and that I may be admitted a claimant.

My lords, and gentlemen,
I am your most humble and obedient servant,
THOMAS MORRIS.

SIR, *Brentford, Dec. 15th, 1790.*

I received yours. You will please to inform the committee, that I signed Mr. Morris's certificate, and am willing to testify, that he has at this time upwards of thirty stocks of bees.

I am, sir, your very humble servant,
FRANCIS SWINDEN.

To SAMUEL MORE, *Esq. Sec.*

V.—*On Extracting Gelatine from Bones*[*].

THE gelatine of bones may be obtained by two different processes, each of which has given rise to a particular manufacture. The one consists in dissolving the gelatine in the bones by means of water, heated under the pressure of two or three atmospheres; and the other by the removal of the phosphate and carbonate of lime in the bones, which are dissolved by the muriatic acid diluted with water.

Before describing this last method, we shall take a rapid glance at the origin of this discovery.

Fougeroux, Bayen, and Charlard, softened the bones by steeping them in acids, which dissolved the phosphate and carbonate of lime in them. Stahl and Hérissant demonstrated long since in their courses of chemistry, the composition of the osseous parts of lobsters and craw-fish, and separated therefrom the reticulated animal substance, which combined into a solid body the inorganic matters (the phosphate and carbonate of lime, &c.) contained in the bones.

Duhamel, in describing the art of glue-making, stated that a superior kind of glue might be obtained from bones, by treating them with a diluted acid.

Nevertheless the method of extracting the animal substances which the bones contain, and freeing them from their other constituent principles, was converted to no useful purpose, until M. D'Arcet made it the subject of a new kind of manufacture. Profiting by the results of his experience, in regulating all the parts of the process of the manufacture, he described his process, and indicated the first application of the gelatine thus obtained to the nourishment of man, in his application for a *brevet d'invention*, which he obtained in the year 1810.

In 1813, the author entered into a treaty to unite his interests with the proprietor of an establishment, in which the bones, deprived of their external animal matters, which alone were employed, had accumulated greatly, being nearly valueless. The first attempts, directed by M. D'Arcet, proved successful, and the alimentary preparations made from the gelatine were submitted to the examination of the Academy of Medicine, and the Philanthropic Society of Paris; as likewise so to a Commission of the Marine for the Colonies, and the physicians of the hospitals. These products were also employed in victualling vessels for long voyages, &c.; and they in general proved salubrious, and capable of being economically substituted for other aliments, which contained less nourishment in the same bulk, and were more expensive. We shall have occasion to make more particular observations on the use of alimentary gelatine, in indicating its employment long afterwards.

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[*] From the *Dictionnaire Technologique*.

Unfortunately the person who had the greatest interest in superintending the application in the large, of M. D'Arcet's processes, and in their improvement, intrusted the most important ones to the workmen; so that very soon the bad qualities of the products showed proofs of the most culpable negligence. The gelatine sold to the hospitals had a blackish tint; the great proportion of acid which it contained attacked the copper of the utensils in which it was cooked; and the solution of the oxide thus formed, caused several accidents amongst the convalescents, to whom the soups were served. These serious inconveniences could not long escape the active superintendence of the skilful directors of these establishments, and after having given two ineffectual warnings to the manufacturer of the gelatine, the farther use of it was stopped: the new alimentary product was excluded from the hospitals, and was decried everywhere. These primary failures, greatly augmented by other causes which we shall hereafter mention, considerably lessened the benefits which this invention promised to afford, and the opportunity of adopting the use of gelatine in the public establishments being thus lost, the successors to the first establishers of the concern were forced to convert into glue the greater part of the nutritive substance extracted from the bones.

The priority of the processes of the manufacture of gelatine, as applied to the nourishment of man, was repeatedly contested with its author. In the year 1814, during the blockade of Strasburg, M. Masseyer, who probably never knew of the process having been put in practice by M. D'Arcet, recommended its adoption for the purpose of augmenting the quantity of food in that city, on the approach of famine. The report of a commission nominated for the purpose of that enquiry, by the prefect, Lezai de Marzenia, made known that the new aliment obtained from bones offered a valuable resource under the circumstances. On the same occasion also, M. Gimbernat, a learned Spaniard, claimed the invention; but he was equally wrong as to the priority of the discovery.

Another *brevet d'invention* taken out in the year 1818, for the manufacture of *ostéocolle*, was evidently for a similar invention with M. D'Arcet's, and the pretended improvements specified were indicated in his first *brevet.*

On the manufacture of Gelatine by the Hydrochloric (Muriatic) Acid.

The principal materials.—The reticular fibrous parts of animal matters are susceptible of becoming in great part converted into gelatine; and, perhaps, it may be extracted from all the bones by means of an acid, sufficiently diluted, so as to act but weakly upon this substance, still preserving, however, sufficient energy to act upon the calcareous salts (the phosphate and carbonate of lime). Nevertheless, all the bones are not equally convenient for this use, as those whose texture is too compact, and which are of considerable thickness, oppose a long resistance to the action of the hydrochloric acid; which, after attacking the exterior parts of the animal tissue, is a long time in penetrating to the interior of the bones.

We should choose those osseous substances, which, being of an equal thickness, offer the most accessible surfaces to the direct action of the acid; so that the manufacturers of gelatine and the glue from bones employ, almost exclusively, the following materials:—

1. Those bones of the heads of oxen and cows, and also of sheep, which are thin and flat.

2. The bones forming the interior of the horns of oxen and cows, which are termed the *pith;* these are perforated with holes like a sponge.

3. The leg bones of sheep, which are thin and hollow, so that the acid readily penetrates them on immersion in it.

4. The flat bones of the ribs of oxen, &c., after being perforated by the makers of button moulds, &c.

5. The thin shoulder blade bones of sheep.

The prices of these different materials are in general founded on the greater or lesser facility of obtaining a greater or lesser part of the animal substances which they contain; and they likewise vary according to the localities and other circumstances.

We may, indeed, replace, for the purpose of extracting gelatine, the bones which are too costly, by those of all parts of the bodies of various animals. Those which we would thus substitute have already been the basis of another manufacture, which consisted in extracting from the hollow and spongy parts of these bones the fatty matters which they contained; and they previously cut them into pieces, in order to facilitate the separation of the fat. It is nevertheless desirable to cut them into still smaller fragments before immerging them in the acid, as by this previous division they become softened much quicker. The hardness of the bones, however, renders this mechanical operation expensive; and the animal substance, after having been exposed to the action of boiling water, may chance to suffer loss in the dissolution of the bones in the acid and the subsequent washings. And, above all, in the act of boiling the bones to extract the fat, they also lose a portion of their gelatine; and, indeed, the consumption which the manufacturers of animal charcoal have occasioned in these bones, have raised their price from five to eight francs the hundred kilogrammes. We thus see that their value from this cause, and the expense of breaking them, is very nearly equal to that of the selected bones abovementioned; and these motives have therefore determined the manufacturers of gelatine, by means of acid in Paris, to reject the employment of them.

Whatever may be the kind of bones intended to be used for the manufacture of gelatine, the process commences with washing them in cold water, in order to remove any foreign matters which would absorb the acid at a total loss of it; they are then put into a vat, and a mixture equal in weight to them, of the hydrochloric (muriatic) acid of commerce, at 22° of Beaume's areometer, diluted with four times its weight of water, is poured upon them. It is indispensably necessary that the mixture in the vats be shaded from the sunshine, as without this precaution we might endanger the solution of the animal substance. And, indeed, the same thing may happen in the shade, in those countries where the temperature of the atmosphere is sufficiently elevated; but in order to avoid this evil the acid may be more largely diluted.

The process of softening the bones must be carefully guarded, not only against an elevation of the temperature, but also against an excess of the acid, lest we should occasion the complete solution of the animal substance. If we do not employ a sufficient quantity of acid, indeed the phosphate of lime will not be entirely dissolved; but in this case, it is only necessary to pass the bones once or twice through another bath of weak acid, and to cease when the softening of the bones has attained the desirable point.

When the operation has been well conducted, and the proper proportions employed, the bones will be in general sufficiently acted upon at the end of ten days; it is easy to judge of this from their softening. We then draw off the acid solution containing the hydrochlorate and phosphate of lime, also a small quantity of the animal matter dissolved in it, and some trifling proportions of the hydrochlorates of magnesia, iron, and manganese.

We then replace this solution, with a weight equal to that of the bones, of a mixture of the hydrochloric acid and water, marking one degree of the areometer, and which we suffer to act for about twenty-four hours upon them. The first solution, acting upon the animal matter contained in the interstices of the bones, acquiring a density much greater than the weak acid which is now added, has a tendency to fall to the bottom of the vat; and the acid substituted in its place reacts upon the phosphate of lime still remaining in the bones, and dissolves it. We then draw off the last solution and let it drain, and replace it with clear water, which insinuates itself into all the parts of the softened bones, diluting and displacing in part the last acid solution.

The two first solutions withdrawn still contain an excess of free acid; and in order that they may become charged with all the phosphate of lime which they can dissolve, they are again poured on another quantity of bones equal to the first. We finally also treat these bones in the same manner as the first, but we employ a quantity of acid about a twentieth part less; and as this twentieth part of it diminishes the quantity, it is fit to form the second bath of one degree; whence it results that a given weight of the hydrochloric acid at 22 degrees is sufficient to soften an equal weight of bones.

When the bones are thus softened, they are immersed in water, as we have before stated; and they are suffered to steep therein for several hours, in order that the water may dilute and wash out the acid solution; we them draw off this weak solution, and replace it by a fresh quantity of water; this still more dilutes the acid solution, and extracts the greater part of it. We may repeat these washings six or eight times, and when it is desirable to economise the water, we may repass successively the solutions drawn off from the vat into another vat, in order to extract a stronger solution. The entire removal of the acid is exceedingly difficult from those parts of the bones which are strongly impregnated with fat; they therefore reserve those parts, in order to employ them in the manufacture of carpenters' glue; and, in order to neutralise the excess of acid, they put some small pieces of marble into the boiler, when they effect the solution of the animal matter.

They then place the bones in a current of running water, in order to be certain that they have removed the whole of the acid solution, dispersed in the organised animal substances; they plunge them into the current, after previously putting them into baskets or nets, or enclosing them in canvas or openly woven linen. The water is thus continually renewed in the interstices of the animal matters, and they are removed from the stream, when they are certain that they no longer retain an excess of acid. To ascertain this, they cut several portions of the bones across, and the napply them to the tongue, to see whether they possess an acid taste; or else they bring the cut part, when moistened, into contact with litmus paper, which it ought not instantly to change to a red colour.

Finally, if after taking them out of the stream, the softened bones are found not to be completely *deacidified,* they soak them in a weak solution of soda, and thus form an insoluble carbonate of lime, and the hydrochlorate of soda (or a solution of common salt); and even supposing, that after these washings there should still remain a portion of this last salt, its presence will produce no inconvenience in the alimentary substances formed of the gelatine.

The gelatinous matter, however carefully prepared, has still an unpleasant smell; this is owing to the presence of a nauseous oil, and the sulphuretted hydrogen usually contained in the muriatic acid of commerce. It is therefore highly important to procure an acid as pure as possible. Another cause of the ill smell of the organic substance extracted from bones, is the presence of a rancid fat. We may remove the disagreeable smell arising from the first of these causes, by a weak solution of the chloruret of lime; and get rid of the sebacic acid, the second cause, by a solution of the sub-carbonate of soda. It is necessary to state, that, after employing these *re-agents*, the animal substances must be well washed.

Several authors have asserted, that the proportions of the earthy salts and the organised animal matter vary with the age of the animals; but, from the experiments of M. D'Arcet, it appeared that these substances were generally found in constant proportions, and that the fat only varied in different parts of the bones, and a little in the bones of animals of different ages. The quantity of gelatine produced depends upon the nature of the bones; the temperature, at the time they are acted upon; the degree of strength of the acid employed; and, more especially, on the care taken in softening them, to prevent the solution of the organised substance in the acid.

From experiments made with considerable care, they generally obtained from the bones about 0,29 of animal substance, insoluble in the weak muriatic acid, and which yielded about 0,26 of gelatine.

In working in the large way, however, it was scarcely possible, in general, to obtain from 100 kilogrammes of bones, more than from 25 to 27 kilogrammes of organised substance; and this, when dissolved, produced from 0,22 to 0,24 of gelatine.

When we have thus obtained the animal matter of the bones in a moist state, we convert it into gelatine by treating it with boiling water; we then dry what has been dissolved, in order to preserve it; and again dissolve it, at the moment before using it, in a quantity sufficient for the intended purpose *.

We must be particularly careful in preserving in a dry state the substance extracted from the bones of the legs of sheep. We commence their preparation, after having sufficiently washed the bones, by cutting them across at each end in such a manner as to separate the spongy parts, which are impregnated with a fatty substance, and would not only give the gelatine a disagreeable taste, but would also prevent the solution from becoming clear. The parts thus cut off serve for the manufacture of common glue.

The tube which remains is then cut into two, lengthways; the pieces thus obtained are next plunged into boiling water for some minutes, and are then laid across ribs of wood, exposed in an open airy place to dry, and from which they ought not to be removed until they have become thoroughly dry. If, however, they still remain rather moist, their drying should be finally completed in a stove.

We shall obtain from these products of a better quality, by rubbing them with a linen cloth, after having taken them out of the boiling water, or by rolling them about in a large hempen sack. By this means, we can free them from a small quantity of the adhering fat. We also detach, by this rubbing, an interior pellicle, which forms one of the concentric layers within the cylinders of these bones, and these also are employed in the manufacture of glue. Some-

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* For certain purposes in the manufactures, it is useful to bleach the animal substance before dissolving it; this may be done either by exposing it while moist to the sulphureous acid gas, or immersing it in that acid, diluted with water. If there also remain in the substance any traces of phosphate of lime, they will be rendered soluble by this means; or we may probably also substitute the muriatic acid for it, in those places where it may not be too dear; for instance, as where it may be economically prepared by the combustion of sulphur. The other acids likewise dissolve the phosphate of lime; but all those, as commonly sold, are dearer than the muriatic acid.

times, in order the better to disguise the form of the bones, and to please the taste of certain customers, they cut the gelatinous cylinders of the softened tubes across, into short pieces, which are in the form of cylindrical rings, and afterwards divide them again into rectangular fragments.

Finally, in order that their appearance may be rendered more agreeable, and their preservation be more complete, they soak the gelatinous pieces, of whatever shape, in a warm solution of gelatine, which, when dry, forms a sort of varnish, and effectually prevents the influence of the atmosphere upon them.

When we would extract the alimentary gelatine from the cellular tissue contained in flat or thin bones, such as those of the ribs, the shoulder blades, &c., before steeping them in boiling water, in order to free them from the fatty matters in which they are enveloped most completely, we rub them with a dry linen cloth.

When the animal matter of the bones is to be immediately converted into alimentary gelatine, we need not dry them, but put them, whilst moist, into a boiler, and add to them one-half their weight of water; we then close the boiler with its lid, and heat it gradually to ebullition; this must be continued several hours. We may considerably accelerate this operation by increasing the ordinary pressure of the atmosphere in the boiler to double its ordinary power, and shall thus obtain a more elevated temperature, corresponding with that pressure.

When the solution is effected, we draw it off into a filtre, furnished with a false bottom of woven wire; the filtered liquid falls either into a double copper vessel, or one formed of copper interiorly, and furnished exteriorly with a slow conductor of caloric, such as a piece of thick woollen cloth. We also cover the vessel, in order to avoid the loss of the heat. We suffer it to rest thus warm during five or six hours, at the end of which period we may either draw off the clear part, and pour it into oblong moulds, or we may leave the gelatine to form a mass when cold, and afterwards cut it into thin plates, which may be laid upon nets to dry, in the manner of glue-making.

The whole of the animal substance is not dissolved in boiling water, under the atmospheric pressure, nor indeed without a very considerable pressure. The insoluble residuum is composed of albuminous matter enveloped in the blood vessels, and also of a compound of fat and lime. These are the substances which remain insoluble after a great number of repetitions of the experiments in the Papin's digestor, and after repeated washings; and, in fact, we think that this process is not capable of removing all the gelatinous matter contained in the bones.

In order to prevent this alimentary gelatine from resembling in form the ordinary glue, which is marked with the threads of the nets upon which it is dried, we may place it upon a canvas of open threads; but, generally, we change its shape in the following manner, at the finishing of the process: the solution of gelatine obtained is poured into flat moulds made of iron tinned plate; these are placed in a stove, where they remain until the gelatine is become sufficiently firm to no longer receive an impression; the drying is then finally completed upon fine linen. We sometimes add to the jelly the juices of carrots, onions, or of meat, in order to imitate the flavour of *bouillon*, and term these preparations *tablettes de bouillon*.

The process which we have described for the manufacture of gelatine is equally applicable also to the glue sold in the state of jelly, termed *colle au baquet*, and to that termed strong glue. We need not take much trouble in obtaining these two productions; it is sufficient, in fact, to soften the bones, by the process we have above indicated (and we need not bestow much pains in removing the fat from the last portions of the acid solution, which is considerably facilitated by the hot solution of the animal substance), and treat them exactly in the same manner as the scraps of skin and tendons, prepared with lime, are employed in the manufacture of strong glue.

In preparing the trembling jelly, or *colle au baquet*, we must dissolve the animal matter of the bones (dry, or their equivalent of the moist gelatine), in ten times its weight of water, by heat, and add about two per cent. of alum, to prevent its too speedy destruction, especially in hot weather; this is left to deposit, either in the boiler or in the copper vessel, clothed as before described; we then draw off the clear liquid into small buckets, with handles of cord affixed to them, and place them in the open air. When it has become cooled to the state of jelly, it is taken by the manufacturers to the consumers of it, who keep it in their cellars till the moment when it is to be used.

Of the Residuums of the Bones.

The residuums of the bones, after their softening, have not been employed till lately: they chiefly consist of the hydrochlorate and the phosphate of lime, dissolved by the muriatic acid, the animal substance also in solution, and the deposit of fatty matter united with lime (in respect to their economical uses we may neglect the small portions of magnesia, silex, alumnie, and the oxides of iron and manganese). If we decant the clear liquid, and saturate the acid with lime, we shall obtain a precipitate of phosphate of lime, and a solution of hydrochlorate of lime, retaining also the animal matter originally dissolved by the acid. This liquid may be advantageously employed in agriculture, and we may render its carriage less costly, and facilitate its approach to a dry state, by employing the heat lost in many of our furnaces. It is a misfortune that the employment of the hydrochlorate of lime, which is known to be useful by many skilful agriculturists, should not be more extended in practice.

If we would prepare the hydrochlorate of lime for use in the manufactures, we must calcine to redness the product of the evaporation carried to dryness. If this process be effected in close vessels, the animal matter becomes a charcoal, easy of separation by washing over the soluble parts from the residuum, and by evaporating the solutions we shall obtain a white hydrochlorate of lime.

The charcoal when washed is fit for several purposes; and it may serve amongst others for painting with.

The phosphate of lime precipitated during the saturation by the carbonate of lime is of so little value, that it is hardly worth the trouble of collecting it. We think, however, that when dried and calcined, it would be very proper to serve for making into cupels, for the manufacture of phosphorus, &c.

We can also recover part of the hydrochloric acid, which holds the phosphate of lime in solution in combination with its base, by concentrating it, and collecting, by a well regulated distillation, a part of this acid.

On the Preparation and Uses of Alimentary Gelatine.

We designate by the name *coarse gelatine* the organic substance extracted from bones, and by that of *gelatine*, this substance converted into dry gelatine, by dissolving it in water and drying the jelly obtained.

The coarse gelatine, whose preparation is less costly, and of whose long preservation we are well assured, we are convinced may be economically employed in victualling the marine. Its organization, which has not been destroyed by heat, defends it against various causes of alteration, it being indeed nearly in the state in which it formed a constituent part of the bones; and well known facts have proved, that, owing to this circumstance, it is susceptible of being long preserved: we shall produce one of the most remarkable extracted from the *Journal de Médecine militaire.*"

M. de Gimbernat having treated with the weak hydrochloric acid the fragments of the bones of the mammoth of the Ohio, and of the elephant of Siberia, animals which, according to M. Cuvier, have been dead more than four thousand years, was thus enabled to extract the animal substance under the form of gelatine; and this which was of the same nature as that obtained from recent bones, was eaten at the table of the Prefect of Strasburg, and was the first instance, no doubt, in our times, of nourishment being derived from animal substances which existed before the deluge. Nevertheless, those bones which are alternately exposed to dryness and humidity, to the cold of night and the heat of the sun, lose in a few years their animal matter on the surface of the fields.

The coarse gelatine is indeed more difficult of solution than the other kind, but it merely requires a heat longer continued, which is seldom a disadvantage in culinary operations, and a fire less lively than for other purposes.

In order to dissolve the coarse gelatine, whether in an earthen pot, capable of bearing the heat of the fire, with a view to employing it in the preparation of bouillon, or in clear water in order to form jelly, we commence with washing it, then put it to steep in water for six or eight hours in summer, and for ten or fifteen hours in winter, renewing the water once or twice: or we wash it the moment it is to be used, and put it cold into the water with or without the other viands, and heat it slowly to the degree of ebullition, and which must be continued till its solution is effected.

We may effect the solution of the gelatine more quickly if we heat it in river water, under a greater pressure than that of the atmosphere, in a vessel having a safety valve, and a roll of linen placed around its edge, upon which the cover is pressed down by means of weights laid upon it.

We may advantageously supply part of the viands by the use of the coarse gelatine, as it is more readily soluble, on account of the free acid which is contained in the muscular flesh (the lactic acid, according to M. Berzelius).

The bouillion made with gelatine, with or without viands, is prepared afterwards absolutely in the same manner as the ordinary bouillon; we may add the vegetables during the boiling, and the salt when it is made. If we would imitate the *yeux* (eyes) which the fat causes in the ordinary bouillon, we may put in a little fresh butter or fat.

The *tablettes de gelatine* or *de bouillon*, prepared as we have above described dissolve, very readily; it is sufficient to pound them to mix them, with cold water, and to gradually heat it to ebullition.

Before we can appreciate the analogy which exists between the bouillon prepared with gelatine, and that made in the ordinary way, we must describe the preparation of this last.

The muscular flesh of beef which is generally employed in the preparation of the bouillon, contains many substances which the boiling temperature converts into gelatine; the tendons which terminate the muscles, the sheaths which envelope them, the cellular tissue which connects their fibres; the blood vessels and the lymphatic vessels; the nerves, the extractive matter; a free acid and salts. These three last substances, soluble in water, concur in giving to the bouillon the taste and smell which characterise it; the extractive matter especially, to which the name of *osmazôme** has been given, is sufficiently proved to be an immediate principle, containing a particular substance, in which resides the greater part of the flavour of the bouillon, and which is susceptible of being altered or volatilized by a quick and prolonged ebullition, or by a too great elevation of temperature.

After what we have thus explained, we shall be enabled to understand the theory of preparing the bouillon: the muscular flesh, on being put into the cold water contained in the vessel at the commencement of the operation, gives up to this liquid a part of the albumen contained in the blood vessels, the osmazôme, the salts, and the free acid.

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* The properties of this substance are, that it is entirely soluble in water and in alcohol, that it is incapable of becoming a jelly, and that it possesses the taste and smell of a good bouillon. It may be obtained by treating with alcohol at forty degrees, the bouillon evaporated with care to a syrupy consistence.

When the whole has acquired the temperature of ebullition, the albumen dissolved in the flesh becomes coagulated, rises to the surface, and forms a scum, which operates as a sort of clarification, and which scum must be removed. The tendinous and cellular tissue begins to dissolve, and from gelatine; this continues to enrich the bouillon, so long as the heat is continued at the proper degree. The adipose cells begin at this time to yield a part of their fatty matter, which has become fluid at this temperature, and rises to the surface of the bouillon. This substance also preventing the contact of the air, retards the evaporation, and concurs in retaining the volatile substance, to which the bouillon owes its agreable odour.

In order to avoid the greater part of this loss, we should generate the least steam possible, and consequently retain the mass at the temperature of ebullition; this will require the assistance of a well regulated fire, which may easily be maintained in Lemare's *Calefacteur*, and in d'Harel's *Fourneaux Potagers*.

The quantity of substance dissolved in the bouillon does not in general exceed the four or five hundredth part of the weight of the liquid; of this, the gelatine forms the greater part: and the extractive matter is about one seventh of the weight of the gelatine; the remainder consisting of the sulphate and hydrochlorate of potash, the lactic acid, &c. The viands, treated as we have described, are composed for the major part of the muscular fibres; these have but little taste, but are nourishing; they retain the coagulated albumen, the substances fit for the formation of gelatine, but which have not been dissolved; the fatty matter remaining in the cells, a little of all the principles with which the bouillon is impregnated; and lastly, the bones, which form about a fifth part of the total weight of most butchers' meat, and which give to the bouillon their fat and their gelatine.

By making a bouillon as much charged as possible with the principles of the beef, and particularly of beef-steaks, and evaporating nearly to dryness, with great care, the clear decoction obtained, we obtain the true *tablettes de bouillon:* these are a kind of brown extract, soft, flexible, elastic, and tenacious; they attract moisture from the air, and have a very strong taste; but the animal fibres when exhausted a second time by decoction in water, and submitted to the action of a press, do not any longer possess the taste of the viands.

The *tablettes* thus obtained may be preserved for a long time, by being inclosed in vessels, which are inaccessible to insects, and impermeable by humidity; when dissolved in thirty times their weight of water they afford a very savoury bouille. But the high price at which this extract is sold by retail, seeing that we do not obtain but little more than a twentieth part of the weight of the viands employed, (even supposing that they be many times treated with boiling water, and the weak decoctions be again employed to treat a new quantity of the raw viands, yet they will cost more than thirty francs the kilogramme*! (hinders them from ever becoming a commercial object. The philanthrophic Parmentier indeed proposed that they should be prepared solely for the use of the army dispensaries, and this, in order that they might instantly restore the strength of those soldiers who had fainted from loss of blood.

Proust, the celebrated chemist, (but lately lost to science), proposed, in a note on these *tablettes de bouillon,* to substitute for them viands of a similar description, dried, and thus reduced to a fourth part of their weight; similar to the *charqui,* which affords nourishment to the Peruvians, and which is prepared by them in the sunshine.

It is easy to see, that what distinguishes the *bouillon de viande* from the *bouillon de gelatine,* is, that the latter contains no osmazôme; but how easy is it too add the lean of beef, which is always employed in the ordinary bouillon. This has always been one of the chief objections made to the employment of the alimentary gelatine; but the members of the Academy of Medicine, who were appointed to examine the process of M. D'Arcet, and the objections which were opposed to it, remark, that the osmazôme constitutes the weakest part of the dissolved matter in the *bouillon de bœuf,* and that the flesh of swine, of calves, and of poultry, contains no osmazôme, but it furnishes, notwithstanding, strengthening jellies; and that, in fact, this principle is chiefly useful in affording an agreeable taste; but which may, however, be replaced, in a certain degree, either by adding to the gelatine three fourths of the viands of beef; or, and which is more economical, to give an odour and a taste to the solution of gelatine, by employing those vegetables whose taste always predominates in the ordinary bouillon.

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* The kilogramme is only equal to two pounds, three ounces, and five drachms, avoirdupoise weight, and the franc being worth ten pence, of course this quantity would cost one pound five shillings.

As to the nutritive quality of the gelatine, that cannot reasonably be denied, as this substance is identically the same with the *hartshorn jelly,* so long recommended as possessing this property. For the rest, it has been demonstrated by an experiment, continued during three months, under the eyes of the members of the Commission of the Academy of Medicine, *a l'hospice de la Clinique interne de la Faculte,* who prepared the bouillon with a fourth part of the viands usually employed, the gelatine and the vegetables, supplying the three other quarters, which they usually gave, of roast meat. The sick, the convalescent, and the servants, perceived no difference between this bouillon and that which was ordinarily distributed to them; it was abundantly nourishing, and they thus satisfied their hunger with a succulent food, instead of the wasteful bouilli which they habitually eat. This very considerable amelioration in their nourishment was nevertheless not expensive: in fact, instead of employing one hundred pounds of viands, in the preparation of two hundred bouillons, and fifty pounds of boiled meat twenty-five pounds only, with three pounds of gelatine, afforded two hundred bouillons of a superior quality, and also twelve pounds and a half of boiled meat. The same experiment also proved the salubrity of the gelatine; since, out of the forty persons who made use of the bouillon, not one experienced the least injury, which could be attributed to the gelatine; their diseases made their ordinary progress, and their convalescency was not longer than under the usual circumstances.

The conclusions of the commission were, that the bouillon from gelatine, prepared according to the proportions given below, had an agreeable taste, and was both salubrious and economical.

M. D'Arcet gave the following receipt to the Philanthropic Society of Paris, for preparing one hundred and ninety-two rations of bouillon, and which the society distributed to the indigent:

	Francs.	Cents.
6 kilogrammes of viands, at one franc	6	0
2,25 of dry coarse gelatine	10	60
100 kilogrammes of water	0	40
2 kilogrammes of common salt	1	0
8 to 10 kilogrammes of legumes and seasoning	1	50
Fuel	2	0
	21	.50

This makes the price of each ration amount to eleven centimes; but if we deduct four francs for the value of three kilogrammes of boiled meat, each ration will not cost more than eight centimes.

In general, we can replace a quantity, more or less great, of the viands, by the gelatine; thus, we may use twenty grammes of this substance, for each pound of the viands saved; and which corresponds, for the ordinary bouillons, to two pounds of water; and add rather more legumes than usual.

By dissolving in the soups made with herbs, or in the economical soups with legumes, from twenty to thirty gremmes of dry gelatine, for each litre of water, we shall not only render these aliments much more nutritive, but

also prevent that debilitating effect, which is at length produced, from the use of a purely vegetable nourishment, on the stomach of man.

It would also be desirable to incorporate the gelatine with gruel, and the other preparations applicable to the making of soups.

The gelatine from bones, which offers a precious rescource on long voyages, and in provisioning besieged towns, need not be applied, merely in the preparation of bouillons; it ought to enter into all the alimentary preparations, where isinglass is employed, and particularly into the compositions of jellies: it may also replace with advantage isinglass in the stiffening of gauzes, the fabrication of artificial pearls, of glazed paper, and the fining of wines; indeed, it may be substituted for the glue of Holland, and the fish glue, in all their employments, excepting in the fining of beer, which, at present, can only be done with isinglass.

VI.—*On Mr.* MURDOCH'S *Claim to the first introduction of the use of the Gas from Coal, in Lighting, on a large scale, in Great Britain.*

WE extract the following from a work just published, entitled "An Historical Sketch of the Origin, Progress, and Present State of Gas Lighting, by William Matthews;" to which we beg to call the favourable attention of our readers:—

"Hitherto we have had only a faint glimpse of that beautiful light, which at a future period was destined to be exhibited in such splendour, and to be so extensively subservient to the public benefit. But we now approach the dawn of a most luminous era, when, by the labours of a few men of great intellectual endowments, chemistry was to assume, as it were, a new form, and to be entitled to a higher rank amongst the sciences, not only as regarded the utility and importance of its processes, but the greater certainty of their results. The elements of the most subtile bodies were to be scrutinised by the genious, sagacity, and persevering industry of Black, Priestly, Lavoisier, Cavindish, and other superior minds, who disclosed to human perception some of those astonishing, though apparently simple principles, which pervade and operate incessantly through the universal range of all existing bodies. How zealous and persevering the application of these ardent votaries of science, whose diversified ingenuity enabled them to follow nature into her secret recesses, and to develope the potent principles by which matter is so curiously, beautifully, and variously modified! This was, perhaps, the most brilliant epoch in the annals of science, for by the philosophical perspicacity of a few individuals in the course of a few years, greater discoveries were made, the arts of civilized man were more extensively improved, and consequently society more essentially benefitted, than had heretofore been effected in any similar portion of time.

" However, both science and art are in their nature necessarily progressive, and whatever impulse may be given to them by the powers of genius, or the efforts of human industry, perfection can be attained only by slow degrees. Thus the advantages to be derived from the useful qualities of coal gas were not obvious to those who first discovered them, and many years elapsed before they were distinctly perceived, and duly appreciated. Mr. Murdoch, of Soho*, has the singular merit of being the person who first applied this gas to any economical purpose; and he also exhibited the mode in which it might be employed, instead of lamps and candles, for all the purposes of artificial lighting. In the year 1792 he used coal-gas for lighting his house and offices at Redruth, in Cornwall[*]; and in 1767 he again made a similar use of it at Old Cumnock, in Ayrshire. At that very large establishment, the Soho foundry, near Birmingham, in 1798, he constructed an apparatus, which enabled him to exhibit his plan on a larger scale than any he had heretofore attempted. Here his experiments were sedulously continued, with a view to ascertain not only the best modes of making, but also of purifying and burning the gas, so as to prevent either the smell or the smoke from being offensive. But the peace, which took place in the spring of 1802[†], afforded him an opportunity peculiarly favourable for making a more complete display of these brilliant lights than had ever been exhibited. The illumination of Soho works on this occasion was one of extraordinary splendour; the whole front of that extensive range of buildings was ornamented with a great variety of devices, that admirably displayed many of the varied forms of which the gas light was susceptible. This luminous spectacle was as novel as it was astonishing, and Birmingham poured forth its numerous population to gaze at, and to admire this wonderful display of the combined effects of science and art.

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* The Soho, near Birmingham, was an establishment as singular in its kind as it was extensive and various in its objects. It might be denominated a kind of theatre, to which men of genius were invited, and who resorted there from every civilised country to display and exercise their talents. The perfection of the manufacturing arts was the great and constant aim of its liberal and enlightened proprietors, Messrs. Boulton and Watt, and whoever resided there were surrounded by a circle of scientific, ingenious, and skilful men, at all times ready to carry into effect the inventions of each other. Mr. Murdoch, Mr. Southern, Mr. Clegg, and Mr. Henry Creighton, the author of the excellent article on gas-lights, in the last supplement to the *Encyclopedia Britannica*, were residents at Soho.

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[*] When Mr. Murdoch resided in Cornwall, he made gas from every substance he could think of; he lighted his house and a street lamp, he had bladders filled with it to carry at night, with which, and his little *steam carriage* running on the road, he used to astonish the people there. Mr. James Watt, junior, in his evidence before a committee of the House of Commons, on the Gas-light and Coke Bill, in 1809, stated, that "he had known Mr. Murdoch for thirty years; that he had communicated to him his ideas respecting the combustion of inflammable gas from coal, in the latter end of the year 1794, or beginning of 1795; that he informed him two years before that period that he had made various experiments in Cornwall, from which he had deduced that a very considerable economy would attend the use of gas from coal in producing light, as a substitute for oils and tallow; and that he had proposed to him, either in 1795 or 1798, that a patent should be taken out for this invention."

[†] The writer of this was one among those who had the gratification of witnessing this first splendid public exhibition of gas illumination, and retains a vivid recollection of the admiration it produced. Mr. Murdoch was assisted in his experiments at Soho by Mr. Southern and Mr. Henry Creighton, both of whom were men of talent and information.

Mr. Murdoch, however, had many difficulties to overcome before he obtained the perfection which he exhibited on this occasion. But as he united scientific knowledge with great practical skill, his perseverance enabled him to triumph. The retorts first used by him were similar in form to the common glass retorts usually employed in chemical experiments; he next made trial of cast-iron cylinders, which he placed perpendicularly in a common portable furnace, and they were calculated to contain about fifteen pounds of coals: but, in 1802, he had recourse to the horizontal mode of setting them. In 1804 and 1805 he varied his plans, and constructed his retorts with an aperture or door at each end, one of them for introducing the coal, and the other for taking out the coke; but this method he found inconvenient and troublesome. In the works which were constructed in 1805 and 1806, for Messrs. Philips and Lee, at Manchester, he tried one of a different kind, which was very large, and had the form of a bucket with a cover to it. Into this a loose grate, or iron cage, was introduced for the purpose of holding the coal; and, by this contrivance, the whole of the coke could at once be drawn out of the retort when the carbonization was completed. This was so capacious as to contain fifteen hundred weight of coal; but afterwards smaller sizes were tried, and in an *elliptical* form. These were found to produce a greater quantity of gas, and the gas also possessed a higher degree of illuminating power. Indefatigable in the pursuit of improvement, he made a great number of experiments, in order to learn under what circumstances not only the best gas but the largest quantity of it could be obtained. He operated upon both large and small masses of coal, varying the degrees of heat as well as the times of his distillations, so that, by a comparison of the results, he might be enabled to form satisfactory conclusions. His labours have proved of inestimable consequence, and must entitle him to be classed with those who have most successfully applied their talents to useful objects, and zealously exercised them for the benefit of mankind.

Mr. Henry Creighton has given a representation of the retorts first employed by Mr. Murdoch, with the mode of setting them; and the use of *elliptical* retorts seems to have been tried by Mr. Murdoch long before they were adopted at the Chartered Gas Company's works, on the suggestion (as has been stated) of Mr. Malam, to whom Mr. Peckstone erroneously ascribes the *invention*. See the article "Gas-Lights" in the supplement to the *Encyclopedia Britannica*. This excellent article may be considered not merely as an abstract of what was known on the subject at the time it was written, but also as an account of what was effected at Soho, in the early trials at gas-lighting. The different kinds of retorts which are delineated in the figures which Mr. Creighton has given in plate LXXXI., from figs. 1 to 8, inclusive, were used by Mr. Murdoch and himself. For purifying the gas they also employed quick lime in various ways; and in one of the methods practised by Mr. Murdoch, he removed all the smell but the gas gave very little light; indeed, all the methods of purification practised at Soho at that period were imperfect. Moreover, burners of every shape that could be devised were tried, with various pressures; and the quantity of light, as compared with that of common candles, was attempted to be ascertained, as well as the properties of different kinds of coal for producing gas.

Mr. Murdoch's own account of the origin and progress of his experiments for the application of gas to the purposes of lighting, instead of lamps and candles, as stated by him in *The Philosophical Transactions* for 1808 is as follows:—

"It is now nearly sixteen years since, in a course of experiments I was making at Redruth, in Cornwall, upon the quantities and qualities of different kinds of gases, produced by distillation from different mineral and vegetable substances, I was induced, by some observations I had previously made upon the burning of coal, to try the combustible property of the gases produced from it, as well as from peat, wood, and other inflammable substances; and being struck with the great quantities of gas which they afforded, as well as with the brilliancy of the light, and the facility of its production, I instituted several experiments, with a view of ascertaining the cost at which it might be obtained, compared with that of equal quantities of light yielded by oils and tallow.

"My apparatus consisted of an iron retort, with tinned copper and iron tubes, through which the gas was conducted to a considerable distance; and there, as well as at intermediate points, was burned through apertures of varied forms and dimensions. The experiments were made upon coal of different qualities, which I procured from distant parts of the kingdom, for the purpose of ascertaining which would give the most economical results. The gas was also washed with water, and other means were employed to purify it.'

"In the year 1798 I removed from Cornwall to Messrs. Boulton, Watt, and Co.'s works for the manufacture of steam-engines, at the Soho foundry, and there I constructed an apparatus upon a larger scale, which, during many successive nights, was applied to the lighting of their principal buildings, and various new methods were practised of washing and purifying the gas.

"These experiments were continued, with some interruption, until the peace of 1802, when a public display of this light was made by me, in the illumination of Mr. Boulton's manufactory, at Soho, upon that occasion.

"Since that period I have, under the sanction of Messrs. Boulton, Watt, and Co., extended the apparatus at Soho foundry, so as to give light to all the principal shops, where it is in regular use, to the exclusion of other artificial light.

"At the time I commenced my experiments I was certainly unacquainted with the circumstance of the gas from coal having been observed by others to be capable of combustion; but I am since informed that the current of gas escaping from Lord Dundonald's tar-ovens had been frequently fired; and I find that Dr. Clayton, in a paper in vol. XLI. of the *Transactions of the Royal Society,* so long ago as the year 1739, gave an account of some observations and experiments made by him, which clearly manifest his knowledge of the inflammable quality of the gas, which he denominates the spirit of the coals; but the idea of applying it as an economical substitute for oils and tallow does not appear to have occurred to this gentleman; and I believe I may, without presuming too much, claim both the first idea of applying, and the first actual application of the gas to economical purposes."

Although Mr. Murdoch engaged in his experiments on coal gas so early as the year 1792, and in some subsequent years, had even applied its use to the lighting of his offices at Redruth, in Cornwall, and Old Crumnock, in Scotland, as well as at the Soho foundry in 1798, he nevertheless made no efforts to excite the attention of others to the subject, till he was prompted to that remarkable and splendid exhibition of it in the spring of the year 1802. Those who were engaged in the works of Messrs. Boulton and Watt were well acquainted with his invention, and it was also known to some scientific men, and to others who were in friendly intercourse with those eminent characters. However, previously to this public display by Mr. Murdoch, the gas had been applied to similar purposes, by a M. le Bon, of Paris. This is related in a letter addressed to the Soho, from which Dr. Henry published the following extract:—" I do not know exactly at what time the first trials were made or published in France. The first notice we received of them here was in a letter from a friend at Paris, dated November 8, 1801, in which he desired me to inform Mr. Murdoch that a person had lighted up his house and gardens with the gas obtained from wood and coal, and had it in contemplation to light up the city of Paris." This is important in the detail of its history, but does not detract from the merit of Mr. Murdoch, nor lessen his claim to the honour of being the first person who introduced its application to useful purposes, on a large scale, in this country.

VII.—*On the different Black Colours. By the late celebrated* William Lewis, *M.B., and F.R.S.*

(Continued from vol. I. page 373.)

IV.—*Attempts to procure an Ink of more durable Materials, concluded:*—On this inquiry it plainly appeared that the ancient inks, whose great duration we now admire, were no other than such as we have been proposing in the present article. Pliny and Vitruvius expressly mention the preparation of soot, or what we now call lamp-black, and the composition of writing-ink from lamp-black and gum. Diascorides is more particular, setting down the proportions of the two ingredients, to wit, three ounces of the soot to one ounce of gum. It seems the mixture was formed into cakes or rolls, which being dried in the sun, were occasionally tempered with water, as the cakes of Indian ink are among us for painting. It may be observed, that the Indian ink is still the writing, as well as the painting ink of the Chinese. The Chinese writing, indeed, is performed in the same manner as painting, with a stiff hair pencil fixed in the end of a reed; but the Romans used a pen, and the inks of this kind are found to answer with a pen nearly as well as those now commonly used. It might be matter of curiosity, at least, and perhaps of utility, for those who have proper opportunities, to enquire more particularly into the preparation of ink in different nations and different ages, and the legibility of the manuscripts of the different periods.

I have already taken notice that all the inks made on the principle I am now speaking of can be discharged by washing, unless the paper admits them to sink into its substance. The ancients were not insensible of this imperfection, and sometimes endeavoured to obviate it, according to Pliny, by using vinegar, instead of water, for tempering the mixture of lamp-black and gum. I tried vinegar, and found it to be of some advantage, not as giving any improvement to the cement, but by promoting the sinking of the matter into the paper. As this washing out of the ink may be prevented by using a kind of paper easy enough to be procured, it is scarcely to be considered as an imperfection; and, indeed, on other kinds of paper it is an imperfection, only so far as it may give occasion to fraud, for none of these inks are in danger of being otherwise discharged than by design. The vitriolic inks themselves, and those of printed books and copper-plates, are all disagreeable; nor can it be expected of the ink maker to render writings secure from frauds.

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* From his *Commercium Philosophico-Technicum.*

Our experiments and reflections on inks having thus led us back to the practice of the ancients, a further improvement occurred, that of uniting the ancient and modern inks together, or using the common vitriolic ink instead of water, for tempering the ancient mixture of gum and lamp-black. By this method it should seem that the writings would have all the durability of those of former times, with the advantage that results from the vitriolic ink fixing itself into the paper. Even where the common vitriolic mixture is depended on for the ink, it may in many cases be improved by a small addition of the ancient composition, or of the common Indian ink, which answers the same purpose: when the vitriolic ink is dilute, and flows so pale from the pen that the fine strokes, on first writing are scarcely visible, the addition of a little Indian ink is the readiest means of giving it the due blackness. By this admixture it may be presumed also that the vitriolic ink will be made more durable, the Indian ink in some measure covering it, and defending it from the action of the air. In all cases, where Indian ink or other similar compositions are employed, cotton should be used in the ink-stand, as already mentioned, to prevent the settling of the black powder.

Though the foregoing enquiries have not attained to the perfection which might be desired, I flatter myself that they will not be found unimportant; that even the unsuccessful experiments, if they contribute nothing in a philosophic view, will at least have this use, that they will lessen the labour to others who may engage in the same pursuit; that a composition of ink has been given of as black and durable a colour, as there are grounds to believe the materials to be capable of producing; that an improvement has been proposed in the manufacture of paper, by which the duration of inks will be greatly prolonged; and that means have been pointed out of obtaining, for purposes where such duration is required, writings as lasting as the paper itself, with fewer inconveniences than those which for all occasions of writing men acquiesced in for ages without complaint.

Of the Dyeing of Woollen Black.

1. *General Observations on the Black Dye.*—The ingredients from which common writing-ink is prepared, green vitriol and astringent vegetables, make the basis of the black dye; the dyeing of cloth black being no other than the producing of an ink in its pores, or impregnating it with the colouring parts of ink already made. There are, however, some variations in the composition of the dyeing ink, if it may be so called, mixtures which prove too perishable when applied superficially on paper, being of sufficient durability when introduced into wool or woollen cloth, and mixtures which make a good black ink on paper making only a brown in the dyer's business.

2. Cloth is generally supposed to be weakened by the black dye more than by any other, on account of the corrosive quality of the vitriol, and which is increased by the heat made use of for making it thoroughly penetrate the subject; though the vitriol of iron is much less corrosive than

the solutions of the metal made in the nitrous and marine acids, it is reckoned more so than the alum and tartar employed in most of the other dyes. The finer the black the more it is thought to weaken the cloth, insomuch that some writers look upon the beauty of the colour, and its durability or innocence to the cloth, as being incompatible with one another, and hence think it advisable to abate a little in both points, and to be satisfied with a colour of moderate fineness, that the cloth may be moderately lasting. A German writer on dyeing, distinguished by the approbation of the celebrated Stahl, places this affair in a somewhat different light. He observes, that the vitriol proves corrosive only so far as it is not saturated with the galls, and that by using a proper quantity of galls, it will be mortified, so as to be incapable of doing any injury to the cloth: to determine the quantity sufficient for this complete saturation, he directs a decoction of the galls and a solution of the vitriol to be mixed together in different proportions, and dropped upon white paper, the liquors being made very dilute, that their colours may be the better judged of; the proportions which give the deepest black colour are those which ought to be followed by the dyer, and by which, according to him, the vitriol is made harmless. The experiments in the foregoing section have shown that about equal parts of galls and vitriol produce the full blackness on paper; and our dyers, so far as I can find, have generally employed the galls in a proportion not less than this, or at least supplied their deficiency by a quantity of other astringents equivalent in virtue; from whence it should follow that the common black dye cannot hurt the cloth. In this point I have not myself had any fair experience, but am assured by a skilful and judicious dyer that black properly dyed has by no means the corrosive quality generally attributed to it, and that the rottenness or perishableness often complained of in black cloths, &c., proceeds only from the cloth having been damaged before the dyeing, for black is the dye commonly had recourse to.

for damaged and unsaleable pieces, and such as have been spoiled in other dyes. Though vitriol, however mortified, be admitted to weaken the cloth, it is pretty clear that black is not the dye which weakens it most, for vitriol is used for some coffee colours, not indeed with so great a heat, but in greater quantity than for the black dye itself; and the aquafortis employed in scarlets, oranges, and some other colours, is certainly more corrosive.

3. For dyeing black, especially on superfine cloths, it is customary to give a previous ground of some other deep colour, and blue is preferred for this ground, as being one of the most innocent dyes in regard to the cloth, and as being of all colours that which has the nearest affinity to black; common black ink and the black liquor of the dyer, when diluted largely with spring water, appear blue, as if their blackness was no other than a concentrated blue. The use assigned for this blue ground by the writers on dyeing is, that the cloth having already a considerable body of colour, may require less of the blackening materials, and consequently be less weakened than if it were dyed directly from white to black. But there is another more important use of it, the blue being essential to the production of the black dye, for without either a blue ground, or a blue superadded to the vitriol and galls, no other than brown dyes are obtained. There are means (see hereafter No. 7), of introducing this necessary blueness along with the vitriol and astringents; but the colour appears more perishable than when dyed upon a blue ground of indigo or woad.

4. The dyers commonly have some blue marks at the ends of the cloth, by fixing pieces of lead on them. by which they are secured from the action of the black liquor, to show that the piece has been regularly dyed on a blue ground, and consequently that the colour may be expected to be durable. This may be discovered, with greater certainty, by steeping a small bit of the black cloth, for a day or two, in water acidulated with a little oil of vitriol; or more expeditiously by boiling it, about a quarter of an hour, in a

solution of alum and tartar, made in the proportion of an ounce of each of the salts to a pint of water. Great part of the black matter being destroyed or dissolved by the saline liquors, the cloth will remain of a blueish black colour, if it has had a previous blue ground; but if it has been dyed immediately from white it will now look of a muddy reddish-brown. The solution of alum and tartar is the assay-liquor for black cloths, directed in the new French regulations, which were drawn up from the experiments of Dufay, and published at the end of Hellot's *Art de teindre.*

5. Stuffs whose price will not admit of the blue dye, are said, by the French and German writers, to be grounded with a deep brown, by boiling them with walnut peels or walnut tree roots. This practice, as I am informed, is never followed by our dyers, who look upon brown as a colour opposite to black, and, therefore, very unfit to serve as a ground to it. Whether a brown ground is useful or otherwise I cannot take upon me absolutely to determine; but thus much I can affirm, that I have known brown stuffs dyed to a black, which was reckoned, by good judges, to look, and to hold its colour in wearing, remarkably well. It should seem, that any deep colour which does not hurt the cloth would be preferable to white; and it may here be proper to observe, that all colours whatever receive a black dye, though black will not receive any other; whence black, as already mentioned, is the last resource for cloths that have been damaged, or had their colours stained or impaired by different accidents.

6. The excellent regulations for the French dyers, drawn up and published by the order of M. Colbert, require the cloth, after it has been blued, to be maddered. In order to fix the colour of madder the cloth must be first boiled with alum and tartar; and as these salts must necessarily contribute to augment the ill qualities that were supposed to result from the black dye itself, and which were endeavoured, as much as possible, to be avoided; it might be thought that the madder was accompanied with some con-

siderable advantage, sufficient to counterbalance that inconvenience, and the addition which it makes to the expense. It has not been found, however, on fair trials, to contribute any thing either to the beauty or duration of the black. M. Hellot relates, that having dyed a piece of cloth of a deep blue, he maddered one of the halves of it, and then dyed both the maddered and unmaddered halves in one copper; both turned out of a good black; but the unmaddered, he says, was evidently the best, the maddered piece having somewhat of a rusty hue. The best way of comparison is, by placing samples of the dyed pieces flat against a full light; that is, with their edges towards the light, and then going back a little, so as to look partly down upon them and partly over the surface; this is the way in which dyers judge of colours. On viewing, in this manner, several samples of blacks, dyed on blue cloth, maddered and unmaddered, I could not perceive that they differed greatly from one another; but was convinced that if the maddered ones are not inferior to the others they certainly have no advantage over them. In some of the old receipts madder is directed as an ingredient in the black dye itself, along with vitriol and galls; but here it is evidently superfluous, its colour not fixing itself in the cloth. Among the reasons alleged for the use of maddering the cloth, there is only one which appears to have any plausibility, viz. that it prevents the black cloth from staining the skin or linen; but all that the madder can do in this respect, as M. Hellot justly observes, is, to discharge the superfluous blue; and this, not in virtue of the madder itself, but of the boiling with alum and tartar preparatory to the madder dye. The same advantage may be obtained by sufficiently scowering the cloth in the fulling mill, after the dye. This is evident from the superfine cloths dyed by our dyers, among whom the injudicious and unfrugal practice of maddering, from such informarion as I have received, appears to be unknown. They have, indeed, a colour called madder black, dyed on baise, for Portugal and Spain; but this depends on another principle, as will appear hereafter.

7. Logwood, which, as we have seen in the foregoing section, is a very useful ingredient in writing-ink, is still more so in the black dye. Vitriol and galls, in whatever proportions they are used, produce no other than browns of different shades. I have often been surprised, that, with the capital materials of black dye, I never could obtain any true blackness in white cloth, and attributed the failure to some unheeded mismanagement in the process, till I found it to be a known fact among the dyers. Logwood is the material which adds blackness to the vitriol and gall brown; and this black dye, though not of the most durable kind, is the most common. On blue cloth a good black may be dyed by vitriol and galls alone; but even here, the addition of logwood contributes not a little to improve the colour.

8. The addition of verdigris, which deepens the colour of the inky liquor, is found also to deepen the dye on cloth; and this improved blackness, very perishable in the ink applied on paper, appears in cloth to be more durable, though not entirely so much as could be wished. The effect of the verdegris seems to proeeed from its action on the logwood: for with galls, and with green vitriol, separately, it produced no tendency to blackness; but with decoction of logwood it struck immediately a deep black, which, when diluted, appeared of a fine blue. This experiment reconciles two observations I have lately met with, one by Mr. Scheffer, in the *Swedish Transactions*, the other by Mr. Hoffman, in a German treatise of economical chemistry, &c. The former of whom relates, that logwood with verdegris gives a blue dye; and the latter, that it gives a black. Blue is the proper colour of the mixture, and the black is a concentration of the blue. Part of the colouring matter of the mixture concretes very speedily into sensible particles, so as to look like a black powder diffused

through the liquor: the liquor is found to pass blue through a filtre, and the black matter which remains on the filtre appears likewise merely blue, when spread thin on paper, or diluted with white powders.

9. Instead of the verdegris I tried a cheaper preparation of copper, blue vitriol. This had somewhat of a like effect, but in a less degree: the colour, on mixture, was less black, and the concretion of the colouring parts less remarkable: the black, or blueish-black, matter being separated by filtration, the liquor proved not at all blue, but purplish or reddish, much like a decoction of logwood by itself; it soon turned to a blue colour when dropped on paper, and exposed to the air; but both the blue and the black were greatly more perishable than those produced by verdegris.

10. Some have preferred vitriols impregnated with a little copper, as that of Dantzick, to the more purely ferruginous English vitriol; not, indeed, suspecting that the copper would add any thing to the colour, as in the foregoing experiments, but from an opinion of its rendering the vitriol more penetrating or corrosive, so as to enable the colouring matter to sink better into the subject. With regard to its adding colour, if the vitriol of copper was even as effectual in this intention as verdegris, which it is very far from being, yet the very small quantity contained in the vitriols recommended could be of no material advantage; and as to the penetration, I believe it will be admitted, that vitriol of iron without any copper is penetrating and corrosive rather more than enough. The Dantzick vitriol, however, appears to have one advantage, not depending on its coppery part, but on the manner of its preparation: greatest part of the English vitriol, by hasty crystallization, is run into large irregular masses, abounding with loose ochery matter, and with watery moisture, if not with foreign substances of other kinds; while the vitriol of Dantzick, more slowly crystallized, is more pure, and consequently stronger. The most perfect vitriol of iron, is that which

is in the most solid crystals of the deepest green colour; not-rusty or yellowish, from its containing an ochre, unsaturated with acid; nor pale, from its being too watery, or holding aluminous or other foreign matters.

11. For producing a black dye on cloth, the cloth is first impregnated with the astringent matter, and afterwards passed through a solution of vitriol, mixed also with astringents. If it was first charged with the vitriolic solution, the colour would not succeed so well, and the cloth would be more damaged: if the astringent and vitriolic liquors were mixed together at first in one copper, the operation would be prolonged, and several repeated dippings would be necessary for introducing into the subject a due body of colour. In the dyeing of great lengths of cloth, where sometimes there is an interval of an hour between the passing of the two ends into the liquor, a little tartar is often added, which does not affect the colour itself, but is supposed to make the dye take more uniformly, and prevent the cloth from being, what the workmen call blotted.

12. If, after the cloth has acquired a full black colour, it be again and again passed through the dyeing liquor, its colour by no means receives any improvement, but is rather debased, and inclined to brownish. An over quantity of the ingredients, employed at first, has a like effect. The less is the quantity of the blackening materials we make use of on blue cloth, provided they are sufficient to give full blackness, the more durable will the colour be in wearing.

(*To be continued.*)

LIST OF PATENTS FOR NEW INVENTIONS,

Which have passed the Great Seal since Nov. 22, 1827.

To Robert Wheeler, of High Wycombe, in the county of Bucks, brewer; for an improvement or improvements on or in refrigerators for cooling fluids. Dated Nov. 22, 1827.—To be specified in six months.

To William John Dowding, of the parish of Bulshot, in the county of Wilts, clothier; for certain improvements in machinery for rollering wool from the carding engine. Dated Nov. 22, 1827.—In two months.

To John Roberts, of Wood-street, Cheapside, engineer; and George Upton, of Queen-street, Cheapside, oil-merchant; both in the city of London; for certain improvements on Argand and other lamps. Dated Nov. 24, 1827.—In six months.

To John Alexander Fulton, of Laurence Pountney-lane, Cannon-street, in the city of London, spice-merchant; for a process of preparing or bleaching pepper. Dated Nov. 26, 1827.—In six months.

To Joseph Apsey, of John-street, Waterloo-road, in the parish of St. Mary, Lambeth, engineer; for an improvement in machinery to be used as a substitute for the crank. Dated Nov. 27, 1827.—In two months.

To Joshua Jenour, jun., of Brighton-street, in the parish of St. Pancras, in the county of Middlesex, gent.; for a cartridge or case, and a method of more advantageously enclosing therein shot, or other missiles, for the purpose of loading fire-arms and guns of different descriptions. Dated Nov. 28, 1827.—In six months.

To Thomas Bonner, of Monkwearmouth Shore, in the county of Durham, merchant; for certain improvements on safety lamps. Dated Dec. 4, 1827.—In six months.

To William Fawcett, of Liverpool, in the county of Lancaster, engineer; and Matthew Clark, of the island of Jamaica engineer; for an improved apparatus for the better manufacture of sugar from the canes. Dated Dec. 4, 1827.—In six months.

To Robert Walter Winfield, of Birmingham, in the county of

Warwick, brassfounder; for an improvement or improvements in tubes or rods, produced by a new method or methods of manufacturing them, and in manufacturing the same; with various other improvements, into parts of bedsteads and other articles. Dated Dec. 4, 1827.—In six months.

To John Meaden, of Milbrook, near Southampton, in the county of Hants, coach-maker; for certain improvements on wheels for carriages. Dated Dec. 4, 1827.—In six months.

To Samuel Wilkinson, of Holbeck, in the county of York, mechanic; for improvements in mangles, which he intends to denominate Ballman's patent cabinet mangle. Dated Dec. 4, 1827.—In six months.

To Maurice de Jough, of Warrington, in the county of Lancaster, cotton-spinner; for an improvement or improvements in machines, adapted for spinning, doubling, twisting, roving, or preparing cotton and other fibrous substances. Dated Dec. 4, 1827.—In six months.

To Thomas Tyndall, of Birmingham, in the county of Warwick, gent., who, in consequence of a communication made to him by a foreigner residing abroad, is in possession of certain improvements in the manufacture of buttons, and in the machinery or apparatus for manufacturing the same. Dated Dec. 4, 1827.—In six months.

To Daniel Ledsam and William Jones, of Birmingham, in the county of Warwick, manufacturers; for certain improvements in machinery for cutting sprigs, brads, and nails. Dated Dec. 4, 1827.—In six months.

To Joseph Robinson, of Merchant's-row, Limehouse, in the county of Middlesex, brush-maker; for an improvement in the manufacture of brushes of certain descriptions, and in the manufacture of a material or materials, and the application thereof to the manufacture of brushes and other purposes. Dated Dec. 4, 1827.—In six months.

To Paul Steenstrup, of Basing-lane, in the city of London, esq. for certain improvements in machinery for propelling vessels; which improvements are also applicable to other purposes. Dated Dec. 11, 1827.—In six months.

To John Harvey Sadler, of Hoxton, in the county of Middlesex, mechanist: for certain improvements on power-looms, for the weaving of silk, cotton, linen, wool, flax, and hemp, and all mixtures thereof. Dated Dec. 13, 1827.—In six months.

To Ralph Bewcastle, of Newcastle-upon-Tyne, in the county of Northumberland, millwright; for a new and improved method of ballasting ships and other vessels. Dated Dec. 13, 1827.—In six months.

To Robert Stein, of Regent-street, Oxford-street, in the county of Middlesex, gent.; for an improvement in applying heat to the purpose of distillation, Dated December 13, 1827.—In six months.

To Frederick Benjamin Geithner, of Birmingham, in the county of Warwick, brass founder; for certain improvements on castors for furniture and other useful purposes. Dated Dec. 13, 1827.—In six months.

To Henry Peto, of Little Britain, in the city of London, surveyor and builder; for an apparatus for generating power. Dated December 13, 1827.—In six months.

To Joseph Anthony Berrollas, of Nelson-street, City-road, in the parish of Saint Luke, in the county of Middlesex, watch manufacturer; for a method of winding up a pocket watch or clock without a key, which he calls Berrollas's keyless watch or clock; and also for a certain improvement, to be applied to his late invented detached alarum watch. Dated Dec. 13, 1827.—In two months.

To Andrew Motz Skene, of Jermyn-street, in the county of Middlesex, esq. a lieutenant in our royal navy; for an improvement or improvements in the mode of propelling vessels through the water, and for working under-shot water mills. Dated Dec. 15, 1827.—In six months.

To John Lee Stevens of Plymonth, in the county of Devon, merchant; for a new or improved method or methods of propelling vessels through or on the water, by the aid of steam, or other means or power; and for its application to other purposes. Dated December 18, 1827.—In six months.

To Thomas Tyndall, of Birmingham, in the county of Warwick, gent.; who, in consequence of a communication made to him by a foreigner residing abroad, is in possession of certain improvements in machinery to be employed in making nails, brads, and screws. Dated Dec. 18, 1827.—In six months.

To John George, of Chancery-lane, in the county of Middlesex, esq. barrister-at-law; for an invention for preserving decked ships or vessels, so as to render them less liable to dry rot; and for preserving goods on board such ships and vessels from damage by heat. Dated Dec. 18, 1827.—In six months.

To Thomas Stanhope Holland, of the city of London, esq.; for certain combinations of machinery for generating and communicating power and motion, applicable to propelling or fixed machinery, as also floating bodies, carriages, and other locomotive machines. Dated Dec. 19, 1827.—In six months.

To William Harland, M.D. of Scarborough, in the county of York; for certain improvements in apparatus or machinery for propelling locomotive carriages; which improvements are also applicable to other useful purposes. Dated Dec. 21, 1827.—In six months.

To Charles Augustus Ferguson, of Mill-wall, in the parish of All Saints, Poplar, in the county of Middlesex, mast maker; and James Falconer Altee, of Prospect-place, Deptford, in the county of Kent, gent.; for certain improvements in the construction of made masts. Dated Dec. 22, 1827.—In six months.

To William Hale, of Colchester, in the county of Essex, merchant; for certain improvements in machinery orapparatus for propelling vessels. Dated Dec. 22, 1827.—In six months.

GILL'S

TECHNOLOGICAL REPOSITORY.

VIII.—*On Artificial Incubation, or Hatching Poultry in Stoves heated by Hot Water continually circulating through them, the fire being also regulated by a Pyrometer; and which methods are also peculiarly applicable to heating Hot-houses, Green-houses, &c.* By M. Bonnemain *.

WITH A PLATE.

The Egyptians have been for time immemorial in possession of a method of hatching chickens without the help of hens, by means of furnaces of a particular construction, known by the name of *mamals*. The inhabitants of the village of Bermé, at certain seasons of the year, also employ furnaces heated by means of lamps in hatching chickens for sale; but their process, the result of long practice, and favoured by the climate of their country, does not generally succeed with others; and therefore, after making numerous experiments, in order to obtain similar results, all those who were engaged in the pursuit have abandoned it, owing to the uncertain success attending it. M. Reaumur has also published many ingenious observations on artificial incubation; but M. Bonnemain, a French physician, is the only person who, after studying with great care all the circumstances which promote the natural incubation, has been able to hatch eggs in a constant, and even more certain manner, than is ordinarily found to take place with the fowls in our poultry yards.

M. Bonnemain's apparatus consists, firstly, of a *calori-*

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* From the *Dictionnaire Technologique*.

fère, intended to cause the hot water to circulate; secondly, of a regulator, adapted to maintain an equal degree of temperature; and, thirdly, of a stove, kept constantly heated to the degree proper for incubation, and to which is also attached a cage, intended to keep the young chickens warm for the first few days after their being hatched. We shall describe these three parts successively:—

The *calorifère* is so constructed as to transmit the heat of the fire to all parts of the stove, by means of tubes, through which the hot water circulates. In plate II., figs. 1, 2, 3, 4, and 5, it is represented in plan, section, and elevation. It is composed of a copper cylindrical fire-place A, containing a grate B, which separates it from the ash-pit. The fire-place is everywhere surrounded with the water contained in the cylindrical boiler C, and which boiler has likewise five tubes, through which the flame, smoke, and heated air from the fire is made to circulate, so that the greatest part of its heat is communicated to the water before it escapes by the chimney.

An *adjutage*, or connecting-joint D, affixed upon the top of the boiler, as shown in fig. 10, forms a communication from the interior of the boiler with the vertical tube D G, and which is united with the horizontal tube E F, to which is soldered a long transversal tube, or adjustment, into which an equal number of tubes, as 6, 8, 10, &c. are fitted. This row of tubes is introduced through the partition wall into the stove, through which it passes in a gently inclining position, and passing out on the opposite side, the same tubes are curved, and again enter the stove about eight or nine inches below; thence passing through it, they again come through the partition wall, and are again bent and passed through the stove, and so on two or three times repeatedly; the two last times, however, M. Bonnemain caused them also to pass through a kind of cage, O, P, Q, and which had a sheep-skin with its wool adhering to it, suspended within it, under which the young chickens could nestle, and keep themselves warm; the row of tubes was then again united into another transversal tube H, at the bottom of the stove, and to which was adapted another tube, which descended to the bottom of the boiler, on one side of it; and also rose above the top of the boilder, and thus becomes convenient both for filling and emptying the boiler with water; but in this case it is necessary to interpose between the mouth of the tube and the bottom of the boiler a capsule of copper, affixed by three branches, so that the heated water should not be directed towards this orifice, and thereby abate in its boiling action; it is also desirable to solder to this tube, along the whole of that part of it which passes through the water, a double envelope full of air, which will prevent the descending water from becoming re-heated before passing into the boiler, and thereby diminish the force of its circulation. An open tube K, raised above the highest point of the first-mentioned tube G, serves to allow the air contained in the water to escape thereby; the other tube L, fitted to the lower part of the boiler, as above-mentioned, but which is raised above the level of the highest of the circulating tubes, has a funnel at the top of it, by means of which the boiler is to be filled with water.

In order the better to comprehend the construction of the *calorifére*, we shall proceed to give a detailed explanation of the figures represented in the plate; the same letters of reference indicating the similar parts in all of them.

Fig. 1. An exterior elevation of the *calorifére*.

Fig. 2. A plan of the upper part of it, its cover being removed.

Fig 3. A vertical section of it, showing the flues or tubes for the products of the combustion to circulate through.

Fig. 4. A plan, taken at the level of the grate.

Fig. 5. A section of the furnace, and its chimney.

Fig. 6. A side elevation of the regulator, and a section of the tube which encloses the iron rod.

Fig. 7. A bird's-eye view of the dial and levers of the regulator.

Fig. 8. A front view of the register door.

Fig. 9. A section of the same.

The four last figures are drawn upon a scale of three times the size of the former ones:—*a*, the fire-place; *b*, the grate; *c*, the ash-pit; *d*, the door of the ash-pit; *e e*, tubes by which the smoke, &c. mounts from the fire-place, through the opening *f*; *g g*, other tubes, down which the smoke, &c. passes from the tubes *e e*; *h*, a larger tube, serving as a chimney to convey away the products of the combustion, which enter it through the two tubes *i i*, and escape though the tubes *gg*; *l*, the exterior case of the *calorifére*, the whole of the space comprised between it and the exterior sides of the tubes and fire-place being filled with water; *m*, the mouth of a corresponding opening, serving to light the fire and clear the grate; *n*, the cover of the furnace; *s*, the register for the air to feed the fire, contained in the box or case *t*, which projects beyond the exterior of the apparatus: the register turns upon the axis *u*, and is moved by a rod or wire *v*; *x* is an iron rod, the lower end of which is screwed, and turns toward the left, in a female screw of brass, *y*, affixed to the bottom of a leaden tube, at the upper part of which is a short square tube of brass, *z*, which acts upon the claw *a* of the carved lever *b*, &c., and the square tube is guided through an aperture, also made square, to prevent the leaden tube from turning round.

All being disposed, as we have above stated, we raise the cover *n* of the furnace, fig. 1, and throw in as much charcoal or wood as will fill one-half or two-thirds of the capacity of the furnace; we then replace the cover again, and open the mouth of the furnace *m*, and introduce thereby some lighted charcoal. When the fire begins to burn, we close the mouth, and open the door *d* of the ash-pit, until a draught is established; we then close all the openings. The products of the combustion, which are disengaged from the fire, are introduced at the opening *f*, into the two ascending tubes *e e*; they then descend the tubes *g g*, and pass through the elbow-pipes *i i*, into the large tube *h h*, and thence to the chimney.

During the passage of the gaseous products of the combustion, they communicate to the water in the boiler a great part of their heat, and finally enter the chimney, at a temperature but little elevated.

We may readily conceive that the water heated in the *calorifère*, rising by means of its specific levity through the tube D, fig. 10, from the top of the boiler, causes a progressive movement through all the tubes, which return again to the boiler a corresponding quantity of water, through the tube R, which is plunged down to its lower part. This circulatory movement once commenced, continues so long as the water is heated in the *calorifère*, because the temperature is never equal throughout all parts of the apparatus. We may readily conceive that a perfect equality of temperature can never exist, on account of the continual loss of heat, which escapes from the exterior of all the tubes; meanwhile the temperature of the air enclosed in the stove differs but little from that of the numerous tubes which traverse it, and as the bends of the tubes on the outside of the stove afford but little surface to be cooled by the surrounding air, so the force of the circulation, which is always in the ratio of the difference between the temperatures of the water passing out of the *calorifère* and reentering it, does not become greatly diminished, even after having expended a large portion of its heat, on the outside of the stove, in maintaining a gentle heat in the cage O, P, Q, adjoining to it.

We see, therefore, that the more the water is cooled which passes through the last circumvolutions of the tubes, the more active is the circulation in all parts, and, consequently, the more equal is the temperature of all the tubes which heat the stove, and of the air within it. Indeed, to prevent the loss of heat as much as possible, the *calorifère*, and all those parts of the tubes which are placed on the exterior of the stove, are enveloped in lists of woollen cloth. M. Bonnemain having thus applied these principles with so much skill, is always enabled to maintain in these stoves an equal temperature, varying scarcely so much as half a degree of Reaumur's thermometer; but, as if it was not sufficient to have thus far resolved the problem, he contrived that this degree of temperature in all parts of the stove should be constantly maintained at that point which was found most favourable for promoting incubation. It was by means of the following apparatus, or *regulator of the fire*, that he attained this desirable object.

The action of the regulator is founded on the unequal dilatation of different metals by heat. A rod of iron *x*, fig. 11, screwed as abovementioned at its lower extremity, is united to a female screw of brass *y*, which is enclosed within a tube of lead, terminating at its upper end in a ring of brass *z*.

The leaden tube is plunged into the water contained in the *calorifére*, by the side of one of the tubes *g*. The dilatation of lead being greater than that of iron, at an equal degree of temperature, and the rod being also enclosed within the tube, it is heated much less than the tube; and when the temperature is raised to the required degree, the lengthening of the tube brings the ring *z* into contact with the claw *a'*, at the shorter end of the bent lever *a'*, *b'*, *d'*; but when the slightest increase of heat again lengthens the tube, the ring *z* raises the claw of the lever, but, by reason of the greater length of its opposite arm *d'*, that end descends much more. This movement is communicated near to the axis of a balanced lever *e'*, placed below the end of the former one, and thereby greatly encreases the motion of the lever *e'*, and which movement is directly transmitted by the iron wire *v*, to the register *s*, which diminishes or entirely suppresses the access of air to the fire. The combustion then abates, and the temperature falling a little in consequence, the leaden tube shortens, and is disengaged from its contact with the claw of the lever *a′, b′, d′*; and the counterweight *g*, fixed on the lever *e′*, causes the other end to rise, and open he air-register *s*, which affords a wide passage for the entrance of the air, when the combustion again becomes active.

We thus see that the temperature of the *calorifére* being thus regulated, in consequence the tubes which circulate through the stove, constantly afford the same quantity of heat for any given time. Nevertheless this condition did not suffice for constantly preserving an uniform temperature in the stove, on account of the temperature of the open air so greatly varying. To counterbalance this influence M. Bonnemain has fitted upon the upper end of the iron rod which supports the regulating tube, an index, so contrived as to turn the rod, and, consequently, the screw *y* at its lower end, so as to lower or raise the leaden tube. In the former case the claw at the shorter end of the lever *a′, b′, d′* falling from it, causes the air register to open, and raise the temperature higher than the dilatation of the leaden tube permitted; and we can thus obtain a higher temperature, and this regularly continued. If, on the contrary, we raise the tube, by turning the index the contrary way, the air register affords a less opening, and thus produces a temperature considerably lowered. We thus see that it is easy to determine, *a priori*, the degree of temperature which we would give to the water, which the *calorifére* causes to circulate through the rows of tubes in the stove. In order to facilitate the means of regulating his *calorifére*, M. Bonnemain caused divisions to be engraved upon a dial plate beneath the index, and inscribed the words "*stronger heat*" or "*lesser heat*" upon it, and which pointed out the direction in which the index ought to be turned, in order to produce the one or the other effect.

M. Bonnemain's *calorifére* and *regulator* may, by means of appropriate modifications, be usefully applied to preserve the temperature fit for vegetation under beds, to produce in all seasons, or in advanced seasons, which are the most beneficial to produce an abundance of early crops of vegetables, such as asparagus, peas, melons, &c. Successful experiments of this kind have already been made at the *Jardin du Roi,* at Paris. And we may also apply this ingenious apparatus to maintain the proper temperatures in green-houses, in apartments, and particularly in stoves, when the *alcoholic* or *acetic* fermentations are to be produced, or the crystallization of sugar-candy, tartaric acid, &c., is to be effected.

When we would hatch chickens, &c., in the stove which we have above described, we light the fire in the *calorifére,* and by means of the regulator, we obtain that degree of heat in the stove which is fitted for incubation; we then place the eggs near to each other upon the shelves with borders to them, M, M, &c., fig. 10, which are fixed under each row of tubes. It is convenient not to cover, on the first day, more than the twentieth part of the superficies of the shelves, and to add every day, for twenty days, an equal quantity of eggs, so that, on the twenty-first day, the quantity of eggs first placed will be for the greater part hatched, so that we may obtain every day nearly the same number of chickens, but which may, nevertheless, be occasionally regulated by the particular season of the year.

During the first days of incubation, whether natural or artificial, the small portion of water contained within the substance of the egg evaporates through the pores in its shell; this is replaced by a small quantity of air, which is necessary to support the respiration of the chick. But as the asmospheric air which surrounds the eggs in the stove at that degree of temperature is either completely dry, or but little humid, so the chick would greatly suffer, or finally perish from this kind of desiccation. The aqueous vapour which exhales from the breathing of the old fowls whilst hatching, in some degree prevents this ill effect; but nevertheless, in dry seasons, this vapour is hardly sufficient; and thus, in order that the eggs may be better hatched in the dry seasons, the hens cover them with the earth of the floor of the granary.

In artificial incubation, to keep the air in the stove constantly humid, they place in it flat vessels, such as plates, for example N, N, filled with water.

When the chickens are hatched, they are removed from the stove, and carried to the cage O, P, where they are fed with millet. They also separate, by means of partitions in the cage, the chickens as they are hatched each day, in order to modify their nourishment, agreeably to their age.

Artificial incubation is exceedingly useful in furnishing young fowls at those seasons when the hens will not sit, and in some situations to produce, or, as we may say, indeed to manufacture a great number of fowls in a small space. P.

IX.—*On the Productian of fine and long Anglo-Merino Wool. By* CHAS. CALLIS WESTERN, *Esq., M. P.*[*]

SIR, *Felix Hall, near Kelvedon, Essex, Jan.* 1, 1827.

I BEG you to lay before the society some samples I inclose of Merino wool: one or two of them are exceedingly curious, and the whole of them, I think, afford proof of the possibility of drawing advantageous results from the cultivation and improvement of this valuable breed of sheep.

The wool in No. 1 will be of three years growth next clipping time; I took it off myself this morning from the backs of two wether sheep. I drew it from the skin with quite as much difficulty as if it had only been of one year's growth, and with as much pain to the animals; they seem to be, if any thing, more sensitive under the extraction; they will be three years old next lambing-time; they are fat, and I estimate the weight of their carcasses, if killed now, at nine stone each. You will observe the strength and elasticity of the wool, and the impossibility of discovering any difference in each successive year's growth. I estimate the weight of one fleece at twenty-five pounds, the other at twenty-eight or thirty in the grease; they will have been in the house two years next clipping time. Their food has been, according to the season of the year, tares and clover, green grass-hay, turnips, mangel-wurzel, and oats.

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[*] From vol. XLV. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce. The society voted the gold Ceres medal to Mr. Western.

I sent two wether sheep to London the other day, the fleece of one of which was of three years' growth, and weighs twenty-six pounds, and which shall be laid before the society if desired. These sheep would have been four years old next spring: the particulars of their weight are as follows.

	st.	*lbs.*	*st.*	*lbs.*	
The two sheep alive	17	1			
	17	6	34	7	
The two sheep dead	11	4			
	10	5	22	1	
Rough fat			8	3½	
Two skins			3	2½	
Two heads			1	0	
Two intestines			2	4½	
Two plucks			0	6	
Blood			1	1½	
	st.	*lbs.*			
The two carcasses	11	4			
	10	5			
	22	1	at 6*s.*		6*l.* 12*s.* 9*d.*

No. 2 contains the wool of six different sheep, which will be two years' growth next clipping time, The sheep now coming two years old, they will have been one year in the house next clipping time: this wool, I apprehend, will be quite long enough for combing without any waste whatever, as the additional growth from that time to next June will be very great.

No. 3 contains the wool from four ram lambs, got by a prime Saxon ram out of picked Merino ewes of my stock, They will, I have no doubt, be long enough for combing; there will be some waste, though not much, as they were very early lambed, and I expect the staple will be very long before they will be clipped, and the quality particularly good.

I inclose some specimens of manufacture also from my wool: the thread was spun by Mr. Wood, of Bradford, Yorkshire, and afterwards wove by Messrs. Oxley, of Norwich. These were made by them, upon experiment, with a little admixture of silk. Four beautiful robes, according to these patterns, were finished, which I presented to the Duchess of Gloucester, the Dowager Ladies Londonderry and Melville, and Lady Petre, and they were greatly admired. An infinite variety of articles are, however, made now of fine wool combed. Messrs. Fryers, whose warehouse is in Bridge-street, Blackfriars, manufacture very largely. I think the wools they make use of, are first crosses of our fine wool sheep, and Merinos, some few from Anglo-Merino, the first clip; great improvements are making, in order to comb shorter wool than could formerly be so treated; but the longer the staple, the better for that purpose.

I also inclose a letter I published on the subject of Merino sheep, three years ago, to which I have little to add, except that I am still further confirmed in the correctness of the statements therein made, and find an annual improvement in the wool and carcass of the sheep. I am more and more convinced I am right in the object at which I aim, that of growing long, fine, strong Merino wool for combing. I am satisfied it is practicable, that the farmer who applies attention and skill to this object, will find an adequate return in the sale of wool and mutton, which latter will meet as ready sale as any other breed of sheep, and a better price by the pound than the larger and coarse sorts.

I have already stated in that publication, that I neither expect nor wish that these sheep should supersede any of our most valuable breeds, but I think there is ample room for their introduction, that the wool opens a new field for our manufacturers, and that the judicious crossing of the improved Anglo-Merino sheep with our native breeds, may very much improve the general quality of our home-grown wool, and consequently, the value of our woollen manufactures.

At the period of the lowest depression of the wool-trade last year, I sold to Mr. Legge, woolstapler, Bermondsey-street, at 14*d.* per pound in the grease. The weights of this year's clip were rather below the average in my printed letter. The crop of wool varies with seasons, sometimes nearly a pound per head, but frequently half a pound between the different years' clip. The three preceding years I sold to Mr. Wood, of Bradford, Yorkshire, at 1*s.* 6*d.* per pound.

It does not occur to me, that any further particulars will be required by the society; but if any more detailed information is desired, I shall be ready to supply it. The growth of fine long wool for combing, and good mutton at the same time, are the objects I aim at, which I have shown to be practicable, and which I think important, whether as relating to agriculture or manufactures: this wool is to be obtained by selecting and breeding from individuals, the staple of the wool of which is the longest, and in some cases, and for particular objects of manufacture, carrying on the fleece a second year; and they must be well fed, not higher than prudence, however, in my opinion, requires that all other breeds of sheep ought to be.

The society, I believe, has directed its views to the encouragement of irrigation; and I beg leave, in consequence, to inform you, that I have irrigated about forty acres with the greatest success. I shall be happy to furnish such particulars as the society may require, and it is in my power to give; and I venture to send a short practical treatise I published in 1824, on the improvement of grass land by means of irrigation, winter floodings, and drainage. It will be seen at once that I address myself to farmers in a country where irrigation is quite unknown, and the uses of water wholly disregarded.

One meadow of fifteen acres is irrigated by the head-water of a mill, which I take only when the miller would otherwise let it go by, and in the winter, or particular periods, when the millers are glad to be relieved from the pressure of too great a quantity. It is at these moments that the water is most valuable, and they occur quite often enough, where the rivers are considerable, to make the finest irrigated meadows possible. I was, of course, obliged to construct a tunnel, to carry the head-water on to my meadow, which will generally be necessary, the length and diameter of it more or less, according to circumstances; but by such means the irrigation of meadows might be general along the whole line of a river, if an arrangement with the millers could be made for that purpose. I am convinced, that in this instance, that is to say upon the Blackwater river, which empties itself at Maldon, the water which the millers would be desirous to get rid of, would, in all cases, amply repay all the expenses attendant upon forming the meadows properly to receive it; the advantages would also suffice to pay any moderate recompence to the millers.

The experience I have had of the benefits of irrigation (my meadows having been completed above ten years) convince me that it is utterly impossible to apply capital to the improvement of land in any way so profitably as by the means of irrigation, and the application of water in all the various ways in which it may be used.

I am, sir, &c.

A. Aikin, *Esq. Sec.* Charles C. Western.

SIR, *Society of Arts, &c. Adelphi, Feb.* 3, 1827.

I am directed to acknowledge the receipt of a copy of your pamphlet, and also of your communication respecting the growth of long wool on Merino sheep.

Your letter and accompanying samples have been laid before the committee of agriculture, who will be glad to receive any additional information on the subject that you may have to communicate.

It is, I believe, the general opinion, that if a sheep is not sheared, the wool will come off spontaneously in the course of the summer; and every one must have observed, that the fleece of sheep kept on commons, or poor hilly pastures, becomes ragged, and separates in flakes a little previous to shearing time. It is also well known, that in Iceland, and I believe in Shetland, the sheep are never sheared, but the wool is pulled off by hand, when it has become loose. In your Merinos it is evident that this annual casting of the coat does not take place. Does this happen also with Merinos treated in the usual manner, and with the other improved breeds of English sheep, or is it a consequence of the housing or cotting system adopted by you, and long since practised with the fine short-woolled sheep of Saxony?

Can you furnish us with a statement of the expenses and profits of housed sheep, comparatively with those of sheep treated in the ordinary manner? The expenses are the erection of cots, the cutting and carrying roots and green crops for food, the increased proportion of hay and other dry food which the cotting system requires, the carting of the manure, the loss of two years' interest on the price of the first clip, and of one year's interest on the second. The advantages appear to be a more economical consumption of the roots and green crops, an increased quantity of manure, the difference in cost between three yearly shearings and one triennial shearing, and the gain, if any, on one fleece of long fine wool, as compared with that on three fleeces of short fine wool. Probably, also, fewer lambs would be lost, and the flock in general would be healthier when cotted than when managed in the usual manner.

Have you any experience on the advantages of salt mixed with the food of sheep? It is largely used for this purpose both in Saxony and Spain, and the health of the animals is said to be much promoted thereby.

When raw wool was the great article of export from England to the Low Countries, the best was that produced in the hilly parts of Shropshire, Worcestershire, Herefordshire, and Gloucestershire. It appears to me very probable that in this district the system of cotting was largely, if not universally, practised, being probably originally adopted as a protection from wolves and other wild animals, as well as from robbers, which long infested these borders of England and Wales. The reason of this my opinion is the frequent occurrence of the word cote or cot, as a termination to the names of villages and hills, in such parts of this district as I am acquainted with. Thus in Longmont forest, in Shropshire, the northern extremity of this district, there are the villages and hamlets of Medlicot, Batchcot, Ascot, Sibberscot, Westcot, Picklescot, Whitcot, &c.; and in the southern extremity, the Cotswold. In other parts of the country also, the word cot occurs, though not so frequently as in that stated above.

I am, sir, &c.

C. C. Western, *Esq.* ARTHUR AIKIN, *Sec.*

SIR, *Felix Hall, Feb.* 9, 1827.

I have received your letter of yesterday's date. The principal object that I had in view was to make known the curious fact, that the animal will carry its fleece, in all its strength and beauty, three years; and hoped that the knowledge of it might induce others to aid the experiment; I have produced the article, such as never was seen or contemplated before, most people supposing, as you did, that sheep shed their fleece every year; and I have given you the butcher's return of the carcass*. The manufacturers must decide the value of the wool: when that is ascertained, farmers will learn the expense of cotting, &c. comparatively with out-door grazing. Let it be understood, however, that I do not propose the wool should be more than two years' growth, which would require, therefore, only one year's cotting, and that the number so cotted should form only a part of the flock, according as was convenient, and that these should be wethers, put up at about sixteen or eighteen months old, and shorn at twenty-eight or thirty months old, when they would be ready for slaughter also: and these should be selected from the wether flock for their wool, taking those best adapted. I am afraid the committee did not understand my statements, probably from want of clearness in my manner. I meant to say, that I thought the powers thus shown by the animal to grow such a fleece, and at the same time yield such a carcass of mutton, were circumstances sufficiently curious to warrant my laying the information before the society, and that I thought the new article might be serviceable for some of the finest of our fancy articles of manufacture, in which the French have excelled us: and I sent accordingly two or three specimens of China crape*, made of fine Spanish wool, grown by me, and manufactured at Norwich. As to the treatment of the flock at large, I have stated my opinion upon what I think sufficient grounds, that in consequence of the excellence of our pastures in England, and our extensive turnip husbandry, and the universal taste for fat meat, we might here exclusively grow a long, strong, and fine wool, as we have exclusively grown, and I believe shall continue exclusively to grow, the long coarse wools; for unless sheep are well fed, it is impossible to grow wool long and strong. The French are importing our long-woolled sheep, and South Down, and a society is formed in Paris for the improvement of their wools. They may grow the South Down; but unless they keep the sheep higher, the long wool will become brittle immediately, and very soon shorter, and inferior in quality for combing. I sell my wool now annually for combing purposes. An intelligent manufacturer whom I saw at Bath the other day, said, he thought it might also be found particularly useful for the warp to take the finest Saxon upon in the woof. Upon the whole, my object is to draw the attention of landowners and manufacturers to an inquiry into the practicability of producing a most valuable and novel raw article of manufacture, and to give them such evidence of probable success as shall warrant their giving the subject some portion of their time and their thoughts.

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* For the excellence of the carcass I refer to Mr. Hudson, of Bond-street.

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* Imitation of China crape made from picked wool of one year's growth.

You ask if I give salt to my sheep? I give them all they will eat; in the spring, when ewes and lambs are feeding in the water-meadows, they eat a great quantity. I can have no doubt of its salutary effects. I gave you as full an account as I could of my water-meadows, &c.

I am, sir, &c.

A. AIKIN, *Esq. Sec. &c.* CHARES C. WESTERN.

P.S.—I cannot tell whether the sheep of this country shed their wools; but I will make a trial of it. I cannot think the difference of feed, or that cotting, will make any difference, except, indeed, that sheep very scantily fed, such as those on the commons, have always a tendency to lose the fleece; and when it comes off so easy, the bushes, &c. and their own scratching (for they are generally scabbed or lousy), by degrees strip them of their clothing. Whenever a sheep is unhealthy his wool becomes loose.

X.—*On Rearing Silk-Worms upon Lettuces only* By *Mr.* EDWARD HEARD, *Chemist.*

SIR, *London, Dec.* 29, 1827.

As your valuable work has occasionally been the vehicle of communicating practical information on the subject of rearing silk-worms, and growing silk in England, I flatter myself the following observations, with the results of a series of comparative experiments, made this year, on the same subject, will not be found uninteresting.

The culture of silk has, for some time past, engaged my labours and attention; I diligently read all that had been written on the rearing of silk-worms in England, for the last forty years; and I have daily weighed the plausible objections urged against their successful propagation, from a scarcity of food, especially of that description of it which they are said to prefer, viz. the mulberry-leaf. I have especially considered the strong argument used of the higher price of labour in this country compared with the continent, to render a competition with foreign markets unavailing: and after the most rigid enquiries and calculations, I am still fully persuaded, from my own experience, that silk may be profitably grown in several districts of the united kingdom.

In elucidation of this position, I shall now proceed to the developement of those facts, upon which my own belief is grounded; and first, with reference to their food. Upon this head, I am clearly of opinion that too much stress has hitherto been laid upon the necessity of confining the worms solely to the leaf of the mulberry-tree.

The prejudice in favour of this diet may probably have arisen from first observing them in a state of nature, feeding on those leaves; and it doubtless has acquired additional strength from learning, that in all silk-growing countries, this aliment is exclusively selected for their use; but it does not of necessity follow, that this is the only vegetable agreeable to their taste, or best adapted for the production of silk. On the contrary, the results of various experiments I have made, have fully demonstrated, that the nature of the food has very little to do with the quantity or quality of the silk produced; these deviations arise from quite different causes, which shall be presently explained. Any vegetable, therefore, which these insects can relish, so as to constitute their daily food, upon which they evidently thrive and attain maturity, is equally well calculated to supply silk of the same quality, and in equal quantity, as that from the mulberry. These conclusions, I am aware, stand quite opposed to the notions generally entertained; but we should be governed by facts alone; and a variety of experiments, rigorously conducted with different species of vegetables, have decisively confirmed my opinion.

I have, during the present year, reared several hundred worms upon a species of lettuce obtained from abroad, which have gone through their successive changes, and spun silk of a quality and in quantity equal to that obtained from a corresponding number, fed entirely on the mulberry-leaf. Indeed, in a few instances, the cocoons were much larger, and the silk double the quantity, in these fed on this lettuce, but on an average there was at least an equality of produce. I have further the pleasure to add, that I have had a second generation of these worms, spontaneously hatched this autumn, which have, throughout their larva state, solely subsisted on this lettuce diet, have attained maturity, and in produce yielded similar results*. The superiority of this description of lettuce, over those indigenous to the soil of this country, consists in it being less succulent, producing very large leaves, less stalk, and consequently affording less opium (which may be injurious to them) than the common lettuce—the worms, too, invariably give it the preference. In a rich soil, placed at a proper distance from each other, they attain an immense size, and are, therefore, more economical. Next year I hope to have the power of ascertaining the quantity and expense of this food per acre, the number of worms it will feed, the amount and value of their produce in silk, and the attendant expenses of this experiment; the results of which, on a future occasion, I hope to lay before the public.

It has been conjectured, I believe, by some naturalist, that the mulberry-leaf "contains a silky tissue," which is animalized by the worm, and afterwards spun: were this the case, and this silky matter exclusively found in the leaf of the mulberry, it would naturally follow, that no other food could supply the insect with the requisite material for forming silk; but the above recited experimental trial, of an exclusive lettuce diet, and its favourable termination, exposes at once the fallacy of such a theory, and confirms the practicability of rearing them entirely on other food.

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* Notwithstanding the coldness of the present month, I have had some moths laying eggs up to the 10th inst., and others which remain in their chrysalis state; these were kept in apartments of the common temperature at this season without fires; a proof that the breed of worms in my possession are now become quite naturalized to this climate, and would stand the winter with very little precaution.

In pursuing these interesting researches, if we examine a worm in the act of spinning, no vestige of silk appears externally: on destroying the animal, and opening its body, there is an equal absence of a silky filament within; a gold-coloured, thick, viscous fluid is usually found, and this unquestionably must be the basis of the silk obtained. It strikes me then, as a probable operation carried on, that this fluid, by a vermicular motion, is gradually ejected into the mouth of the animal, where it undergoes a change, either by the abstraction, or absorption of some principle, which renders it convertible from a fluid to a solid state, gives it tenuity and susceptibility of being drawn into a long continuous thread, by the natural instinct and efforts of this industrious animal, until the whole of this juice is thus expended, and then it proceeds to enter into another state of existence, in which it has its last and most important duty to perform, that of perpetuating its species.

To return from this digression, I assume it, then, as a fact, sustained fully by my own experiments, that whatever description of food this insect can consume, which ripens it to maturity, and preserves its animal juice in a healthy state, is doubtless fit for the formation of silk; but the quantity must, in a great measure, depend upon the species, size, and constitutional energies of the individual worm, a variation often observable in those fed on mulberry-leaves, as well as with any other diet.

But the primary cause of a defect in the quality and deficiency in the quantity of silk obtained from these insects (commonly attributed to the quality of the food), proceeds, in reality, from errors in the treatment of these animals.

When too great a number are congregated together, and no adequate provision made to remove, frequently, their ordure, in order to keep them perfectly dry and clean; when irregularity in the hours of feeding occur, and their food is not administered free from moisture, and in proper proportions, to avoid waste, being trampled on, or covered with their excrement; when the bodies of those who have died in their various sicknesses are not speedily removed, to prevent contamination; when ventilation is neglected, and a proper temperature not preserved, disease will inevitably be the consequence; the functions of the animal become impaired, and such a state of imbecility will necessarily produce a deteriorated quality, and a diminished quantity of silk.

It is to this cause principally, and not to the quality of the food, that such discrepancies are owing; for it is a well ascertained fact, that these animals will not devour food injurious to their existence; and as lettuces are proved to be as good food for them as mulberry-leaves, and can be cultivated in all seasons, in sufficient abundance, the main difficulty of their propagation, and immediate maintenance in this country, is thus obviated.

I advert to their immediate maintenance on lettuces, with the view of allowing the numerous plantations of mulberry-trees now raising by the "Incorporated Silk Company," and other spirited individuals, to attain a proper size, in order to supply hereafter an additional, but not exclusive, stock of food; and with the intention of lessening the expense of silk establishments, I would strongly recommend the growth of the black mulberry, as well as the white, (now exclusively preferred) aware that an excellent wine may be prepared with their fruit, under proper management, little, if at all, inferior to foreign produce.

Secondly, with regard to labour.—Under this divisional head, I shall briefly remark, that the price of the labour of women and children, who would, in these operations, be chiefly employed, in some parts of England and Wales, is exceedingly low; and especially in Ireland, where I have known men to receive only sixpence or eightpence per day, and women and children proportionably less; the value of labour would, consequently, be nearly on a par with several parts of the continent, where silk is grown; but as creating employment for the lower classes must, at this time, be a primary object with the legislature, from an admitted redundancy of population in that country, the silk establishments offer very weighty political motives for their encouragement.

Thirdly, on the subject of climate.—On this ground there is very little room for objection; as the successful experiments which have, from time to time, been made in the rearing of silk-worms in England, decisively prove that our temperature is by no means unfavourable to their growth and productive industry, and that even in some respects it possesses peculiar advantages over the southern parts of the continent. It appears, however, from late enquiries, that in Europe especially, recourse is had to an artificial climate, for rearing these insects; consequently, atmospheric changes, to which they are not necessarily exposed, can prove no impediment to their successful propagation in this country, pursuing the same system as abroad.

Lastly.—There is a consideration which, above all others (in the culture of silk), demands our most grave and immediate attention, and it has, I fear, been much overlooked, or not generally known.

It is an ascertained fact, that there are different species of the silk-worm, some yielding even more than double the quantity of silk that others do; and this silk of a superior quality and colour. It would, I conceive, be well worth the expense (to any enterprising individual embarking in such a concern) of sending an intelligent traveller to every silk-growing country, in order to collect the eggs of these different species, and glean all necessary information relative to their habits, local mode of treatment, products, and relative value; and I flatter myself the results of such inquiries would amply compensate the expenses attendant upon such a mission.

I have thus hastily glanced at the principal objections urged against the growth of silk in this country; I have endeavoured to point out, that they are remediable by the substitute proposed, and the mode of treatment recommended. I have shown that the crops of silk may be doubled, by a second generation, in our common temperature; and by artificial heat and suitable ventilation, with other concurrent precautions, may be made to yield even three or four crops of silk in succession the same year; and that each of these crops may be rendered of still greater value in produce and in quality, by a judicious selection of the finest breed of worms. In conclusion, I can truly add, that as it is a pursuit to which I have devoted much labour and time, and derived great pleasure from it, I shall feel amply gratified, if the results I have here presented of my comparative experiments on the subject of food, and the important facts they tend to establish, should lead to the further prosecution of more extensive trials, and thus afford encouragement to a species of industry, new, it is true, but pregnant with many advantages, in every point of view, and well calculated to advance the manufacturing and agricultural interests of this country.

I have the honour to be, sir,
Your very obedient humble servant,
To T. Gill, *Esq.* Edward Heard.

Note.—The French mode of heating hot-houses, described in the present number, seems admirably adapted to the rearing of silk-worms.—Editor.

XI.—*On Colourless Lac Varnish. By Mr.* GEORGE FIELD, *of Syon Hill Park, Isleworth; and Mr.* HEN. LUNING, *of Apothecaries' Hall, London**.

THE varnish prepared by dissolving shell-lac in alcohol is, in hardness and brilliancy, superior to all others, except, perhaps, copal varnish, but can rarely be employed by the painter, on account of its dingy, muddy, yellowish brown colour. The society have for some years endeavoured to draw the attention of artists to this subject, by offering a premium for lac varnish sufficiently colourless for the use of painters. The premium was claimed during the present session by Mr. Field and Mr. Luning; and on examination, the processes of each of these gentlemen appearing to answer the intended purpose, the society have thought fit to reward both of them.

Mr. Field's process is as follows:—

Six ounces of shell-lac, coarsely pounded, are to be dissolved by gentle heat in a pint of spirits of wine. To this is to be added a bleaching liquor, made by dissolving purified carbonate of potash in water, and then impregnating it with chlorine gas, till the silica precipitates, and the solution becomes slightly coloured.

Of the above bleaching liquor add one or two ounces to the spiritous solution of lac, and stir the whole well together; effervescence takes place, and when this ceases add more of the bleaching liquor, and thus proceed till the colour of the mixture has become pale. A second bleaching liquid is now to be added, made by diluting muriatic acid with thrice its bulk of water, and dropping into it pulverized red lead, till the last added portions do not become white. Of this acid bleaching liquor small quantities at a time are to be added to the half bleached lac solution, allowing the effervescence which takes place on each addition to cease before a fresh portion is poured in. This is to be continued till the lac, now white, separates from the liquor. The supernatant fluid is now to be poured away, and the lac is to be well washed in repeated waters, and finally wrung as dry as possible in a cloth.

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* From vol. XLV. of the Transactions of the Society for the encouragement of Arts, Manufactures, and Commerce. The society voted the sum of twenty pounds to each of the candidates. In our last volume, p. 303, will be found Professor Hare's, of Philadelphia, method of effecting this important object.

The lac obtained in the foregoing process is to be dissolved in a pint of alcohol, more or less, according to the required strength of the varnish; and after standing for some time in a gentle heat, the clear liquor, which is the varnish, is to be poured off from the sediment.

" White lac varnish," says Mr. Field, " as above prepared, and used in a temperature of not less than sixty degrees, dries in a few minutes, and is not afterwards liable to chill or bloom; it is therefore applicable to drawings and prints which have been sized; and may be safely and advantageously used upon oil-paintings which have been painted a sufficient time, as it bears out colour with the purest effect. This quality prevents its obscuring gilding, and renders it a valuable leather varnish to the bookbinder, to whose use it has already been applied with happy effect, as it does not yield to the warmth of the hand, and resists damps, which subject bindings to mildew.

" As lac is the basis, even in name, of all the metallic lackers, colourless lac may afford silver and steel lackers, with little or no obscuration of their lustre. Its varnish polishes better than any other, and is applicable to some uses of the jeweller, to which purpose it has also been applied, as it has also successfully to the varnishing of light-coloured woods, and cabinet work, to which it is applicable in the manner of French polish; and there can be no doubt it would afford coloured lackers and varnishes of superior quality. In fine, the white lac varnish is generally applicable to the various purposes of other white hard spirit varnishes, and is to be used under the same conditions, and with the same management."

CERTIFICATES.

SIR, *No. 3, Norris-street, Haymarket, April* 28, 1827.

I am desirous of certifying to the Society of Arts, &c., that, having been in the continual habit of using lac and amber varnishes fifty years, I have tried and proved the superior excellence of Mr. Field's white lac varnish, which I consider a most valuable discovery for the arts. I beg to assure the society, also, that I was authorized by an eminent artist and manufacturer, who had also used and approved it, to offer Mr. Field one hundred pounds for the purchase of his process.

I am, sir, &c.

A. AIKIN, *Esq. Sec.* GEORGE VEALE.

SIR, *Harley-street, May* 2, 1827.

I am requested by Mr. Field to give my opinion of the white spirit varnish, made with gum lac and spirits of wine by him, and submitted to the Society of Arts for their premium.

I am happy to have it in my power to give my testimony in its favour, as I cannot conceive it possible to make a spirit varnish from so hard and highly-coloured gum, so perfectly colourless and manageable in its application, more pure and excellent in any respect.

I am, sir, &c.

A. AIKIN, *Esq. Sec.* W. BEECHEY.

SIR,

As I have been informed that the society will meet this evening, and that the merits of Mr. Field's varnish will come under its consideration, I conceive it a duty on my part toward him to express the very high opinion I have formed of it for hardness, transparency, rapidity in drying without tackiness, and the total absence of that worst of vices in the mastic and others, the vice of blooming. I have through life been in the habit of talking with artists on subjects always considered as desiderata amongst us;

and the one most frequently mentioned was a varnish possessing the above qualities. On such occasions I have frequently heard the wish expressed, that lac could be deprived of its colour, as thence we might hope for that which is now proved possible, a perfect varnish.

For myself, I can only be grateful for the individual advantage my own profession, that of painting, has received; but it appears, from various conversations I have had with persons in the habit of using varnishes over woods and metals, that its hardness without brittleness, and its colourless beauty, will give it a general value.

I am, sir, &c.

A. AIKIN, *Esq. Sec.* G. F. JOSEPH.

SIR, 10½, *Titchfield-street, April* 30, 1827.

I have tried Mr. Field's varnish, and find it excellent, both in hardness and goodness of colour, which is whiter than any I have been in the habit of using, and which varnish above mentioned does not get yellow.

I am, sir, &c.

A. AIKIN, *Esq.* Sec. J. VARLEY.

DEAR SIR, 191, *Regent-street, May* 2, 1827.

I have tried your white lac varnish upon coloured engravings, and highly approve of its colour and hardness. It certainly works very free, and dries well. I therefore hope it will receive the favour of the Society of Arts.

I am, sir, &c.

MR. FIELD. R. ACKERMANN, Jun.

DEAR SIR, 6, *Cirencester-place, Fitzroy-square, May* 2, 1827.

Hearing that your lac varnish is before the Society of Arts, I beg to add my testimony to its excellence. I have tried it, and find in it every property that can be wished for in a spirit varnish. I have made many experiments in varnish-making myself, and use chiefly what is of my own manufacture, because I cannot depend upon what is to be had at the shops; but I shall confidently use your's for every purpose when I want a spirit varnish.

I am, sir, &c.

Mr. Field. J. Linnell.

In examination of Mr. Field's varnish by the committee, it was found slightly to change the colour of test paper, indicating the presence of a little acid; on which it became a question whether the more tender of the colours used by painters were likely to be affected by it. This discussion produced the following letter from Mr. Field:—

SIR, *Syon Hill Park, April* 28, 1827.

I beg respectfully to suggest to the committee, that if my white lac varnish contained chlorine it would bleach test-paper, instead of which it only reddens it, in common with other spirit varnishes. Colours, which could be injured, however, by so weak an agency, would be of no value; indeed, many pigments are heightened and improved by acids. I find, also, that the brown lac varnish, mastic varnish, poppy oil, and even spirit of wine, redden test-paper. Artists are in the constant use of vehicles even less neutral than these, such as vinegar, oils bleached by acids, and mucilage used in water painting, which is seldom free from acidity; while acetate of lead, and the sulphate of zinc, are constantly employed as dryers, without apparent injury to colours, some of which are salts, as verdigris, &c., and few of them are perfectly neutral; add to which, I do not find that bright iron, steel, &c., lackered with my varnish, become in the slightest degree tarnished.

I have accompanied this with a specimen of my varnish, which does not change test paper, and I am confident it may be completely edulcorated in the preparation, so as not at all to affect it.

As a further proof of its not having any property injurious to colours in its present state, I have varnished a coloured diagram, the colours of which are of my own preparing, for inspection of the committee, without the previous usual defence of an intermediate sizeing; and as the ultra-marine therein (which, though otherwise the most durable of colours, is instantly destroyed by an acid), and also the madder colours (which, resisting entirely the action of light and oxygen, are yet readily destroyed by chlorine), are both unaffected by this varnish, as are also the other colours of the diagram, I think my long experience in such things justifies me in pronouncing it perfectly innocent with regard to colours.

I am, sir, &c.

A. Aikin, *Esq. Sec.* GEORGE FIELD.

Mr. Luning's process is as follows:—

Dissolve five ounces of shell lac in a quart of rectified spirit of wine; boil for a few minutes with ten ounces of well burnt and recently-heated animal charcoal, when a small quantity of the solution should be drawn off, and filtered; if not colourless, a little more charcoal must be added. When all colour is removed, press the liquor through silk, as linen absorbs more varnish, and afterwards filter it through fine blotting-paper.

In cases where the wax contained in gum lac would be objectionable, filter cold; if the wax be not injurious, filter while hot.

On comparing Mr. Luning's varnish with Mr. Field's, in the state in which each was sent to the society, the former was of a much thinner consistence, and was rendered turbid, by scales of wax and a few particles of charcoal floating in it. On passing it through common white filtering-paper, the impurities were separated, and the liquid came through in a more completely colourless state than Mr. Field's. This seeming advantage was, however, owing to the much greater state of dilution of Mr. Luning's varnish; for, when brought by evaporation to the consistence of Mr. Field's, they each appeared as nearly as possible of the same very pale yellowish tint; so that for the use of the painter and varnisher they may each be called equally colourless.

Mr. C. Varley having made some interesting comparative experiments on the the two varnishes, his letter to the secretary detailing the same is here added.

SIR, 52, *Upper Thornhaugh-street, March*, 31, 1827.

I have varnished some of my sketches with Mr. Field's lac varnish, and some with Mr. Luning's ditto.

Mr. Field's varnish appears to me to answer all that can be expected from a varnish. It may be laid on as freely as any other varnish, and dries quick, brilliant, and transparent. It is superior to all other varnishes in its approach to a glassy surface, and in freedom from tackiness. It is about a right strength or body, though I prefer a sample I had before from Mr. Field, which is as thick as can be laid on; for it is desirable for a varnish to be as thick as will allow time for it to be spread on, because it then thickens so soon, that its solvent has no time to act on the oil or colours of the picture.

Mr. Luning's varnish is a great deal too thin, and therefore requires two or three coats before it will bear out; and then, owing to its thinness, the activity of the spirit softens the first coat of varnish, and renders it uneven. It is not so brilliant as Mr. Field's, owing to the mixture (not solution) of wax, and is rather dirty, from the wax retaining some of the charcoal. Therefore I most decidedly give the preference to Mr. Field's varnish.

I have succeeded in throwing down both the wax and charcoal by adding spirit (essential oil) of turpentine, which dissolves the wax, and the solution then becomes sufficiently heavy to separate from the varnish; it requires at least one of spirit of turpentine to three of the varnish before the former is heavy enough to separate, and then it is scarcely a liquid, and separates very slowly; but if more spirit of turpentine is added, it goes down quicker. The varnish dissolves a small portion of the spirit of turpentine, which I feared might be an evil, when drying: but I cannot perceive that it makes any difference. Mr. Luning's varnish, when so freed, appears more colourless than Mr. Field's; but, if brought to the same strength, there would be very little difference; but probably a union of the two processes may produce the varnish like water, though the colour of each is at present equal or superior to most of the varnishes now in use, and will therefore stand at the head as the chief varnish.

I am, sir, &c.

A. Aikin, *Esq.*, *Sec.* Cornelius Varley.

In the Philosophical Transactions, vol. LXXXIV. is a chemical examination of lac by Mr. Hatchett, from which it appears, that one hundred parts of shell lac consist of 90·9 resin, 4 wax, 2·8 gluten, and 0·5 extract. Cold alcohol will take up eighty-one parts of the resin, and leave the wax and gluten untouched; it would, therefore, probably, be an improvement on either of the above processes, to make the first solution of the shell lac in cold, instead of in warm or boiling alcohol.

XII.—*On the Microscope. By the* Editor.

To prepare Straw, for viewing it under the Microscope.—When straw has been steeped a short time in a solution of pearl-ash, rendered still more caustic by quicklime, then washed in water and dried, it will be found to have lost its rigidity; and, on placing a very small portion of it, of an eighth of an inch square only, for instance, between two slips of glass, with water, and rubbing the one slip over the other a few times, the straw will generally be found to separate, or be decomposed, and to display its admirable and beautiful structure under the microscope. The chief part of it consists of long slender filaments; of plates or scales, with ragged or toothed edges all around them, and united, as it were, by a kind of suture, with air-valves interposed at regular intervals between them; and in some places there are tubes or pipes, kept distended by means of oval rings, or hoops placed within them, at equal distances apart; whilst in others, spiral wires are enclosed. In the course of rubbing, these oval rings and spiral wires will frequently become loosened, and completely separated from the mass, so as to be distinctly visible

On viewing the Fungi, or cause of the Smut in Wheat.—On taking a very small slice of the stem of wheat that had become spotted with smut, and placing it between two slips of glass wetted with water, and rubbing them over each other, the black spots separated and diffused themselves through the water; and upon subjecting them to the test of the microscope, presented the forms of the fungi, so admirably delineated by the celebrated Mr. Bauer, in the late Sir Joseph Banks's excellent paper, on the causes of the smut in wheat, published in the Royal Society's Transactions. A lens, the twentieth of an inch focus, is fully sufficient for displaying their forms. The manner of growth, or adhesion of the fungi to the stem, was also clearly shown in several of the parts of the slice.

On the Discovery of two sets of Teeth and Jaws in the mouth of the Cheese-mite. By T. CARPENTER, *Esq.*—The Editor was lately invited, by Mr. Carpenter, to bring his Varley's single microscope to his house, in order to prove its powers by the inspection of a few test objects. He accordingly went, as requested, and had the pleasure to find that its performance equalled all the microscopes Mr. Carpenter had tested, in the trial of difficult objects, with the exception of Mr. Tulley's last compound achromatic one; and even that in one object only: so that the Editor has abundant reason to be satisfied with his Varley's microscope, of which he has published an accurate description, with two plates, in vol. IX. of his *Technical Repository,* and can only wish that other single microscopes may be made equally perfect. Mr. Carpenter was particularly struck with the abundant field of view, which he had no conception could have been obtained in the single microscope.

After having tried the feathers of the Menelaus, the cabbage-butterfly, and others, which presented no difficulty in viewing them; he laid before the Editor an object, placed upon a slip of glass, and covered with a slice of talc; telling him, that he had endeavoured to discover the ana-my of the mite, but not mentioning in what particular pect. However, upon submitting the object to the roscope, the Editor quickly found, that two sets of teeth the jaws were most beautifully displayed on each side e object. On mentioning this, Mr. Carpenter said t ere what he wished to try the power of the micro-sc ith, but would not have previously mentioned them, but he Editor have found it out himself. The teeth are, ay be supposed, exceedingly delicate, but are most ictly displayed, and form exquisite microscopic objects hey were obtained by placing the mite between two sli glass, wetted with water, and sliding the one over the r.

Mr. C ter stated, that the mite he experimented upon, was lry specimen. He has since tried several others in th me way, but not met with the desired success, neither as the Editor succeeded in similar attempts. It has been suggested by a friend, that possibly the mite in question had been partly dissected by other mites, and thus more readily yielded to the trial. However, the experiment is well worth repeating; and, at any rate, it affords a curious fact in natural history.

On the Apparatus used by the Fly, termed the Horse-stinger.—Mr. Carpenter, who is an excellent entomologist, mentioned to the Editor, that he was accustomed, when riding on horseback, to suffer his horse to stop, upon being attacked by any insect, until he had freed it from the annoyance; and that in this way, he had frequently met with interesting objects for his microscope., Amongst others, he showed the Editor the extensive set of apparatus, employed by the horse-stinger fly; consisting of no less than six instruments, namely, a sheath, two knives, two finely-toothed saws, and a tongue; and all of which he had beautifully displayed, so as to form a most interesting object for the microscope.

On the Apparatus employed by the Female Cynips in laying its Eggs.—Mr. T. Carpenter has furnished his namesake, Mr. Philip Carpenter, optician, of Regent-street, with two beautifully displayed objects for his microcosm; being a male and a female cynips. The female lays her eggs upon the wild rose-tree, and causes those well-known mossy excrescences to form thereon, in consequence. It was from one of these excrescences, shut up in an insect box, covered with muslin, as usual, that the pair of cynips were bred. The female has an apparatus attached to the hinder part of her body, consisting of the two parts of a sheath, between which is ordinarily placed a slender tube, having its end triply cleft, and whose office is to convey the eggs into the punctures made by the insect for receiving them. This tube is exposed perfectly to view, in the above object.

On an Apparatus made by Mr. John Cuthbert, *Optician, for viewing the Animalculæ in Water.*—On the Editor calling upon Mr. Cuthbert lately, he showed him a small apparatus, in which he had kept nine or ten wheel animalcules alive, and in full vigour, for upwards of a week, so as to be at all times ready for inspection in the microscope.

This apparatus consisted of two short cylindrical brass tubes, ground accurately together, so as to fit air-tight, the one within the other. Each of these tubes had a flat polished glass plate fitted into its upper end, by having a recess formed in each to receive the glass, and which was afterwards securely affixed therein, by burnishing the rim over it. The aid of bee's-wax was also called in, to render the juncture air-tight, previously to the act of burnishing in the glasses.

The uppermost of the two glasses was ground very thin, so as to admit of high magnifying powers being employed. And the innermost and longest of the two tubes, had a border or rim at its lower end, which projected sufficiently beyond the outer tube to allow of it being taken hold of, in adjusting the tubes. The drop of water containing the wheel-animalcules was not more than the eighth part of an inch in diameter. And we have been informed, by an intelligent friend, that it was necessary to have a very small hole made through the outer tube, just below the glass; and which hole was then closed up with bee's-wax, to prevent the evaporation of the water.

This apparatus is a vast improvement, indeed, upon the bug box, ordinarily supplied with microscopes.

On the Apparatus used by the Harvest Tick.—Mr. T. Carpenter showed the Editor one of these troublesome insects, which had been extracted from the leg of one of his friends, by picking it out with a needle. It was furnished at its head with a straight two-edged serrated weapon, like the blade of the saw-fish, only that the teeth of the saw were inclined backwards; so that though it could readily make its way by burrowing underneath the skin, it had not the power of retracing its path.

On the Teeth of the Tad-pole.—Mr. Carpenter had a set of these very delicate teeth, beautifully displayed as a microscopic object, and which he also showed to the Editor. We sincerely wish that Mr. Carpenter's success in these minute and interesting dissections may encourage others to pursue the same study.

(*To be continued.*)

.—*On the Advantages of Deep Ploughing and Manuring, in making Plantations of Forest Trees. By* W. Withers, *Jun. Esq.*[*]

SIR, *Halt, Norfolk, Oct.* 28, 1826.

The principal object of the present memoir is to communicate to the society the result of several experiments on manuring land for forest trees, as well as to demonstrate the absolute necessity of deeply ploughing or trenching land previous to planting, and of keeping it clean and free from weeds, for some years afterwards. I had myself been long satisfied that this latter method was indispensable to insure success upon land such as is usually selected for planting, and believed most other planters were of the same opinion; but, notwithstanding all that has been said and written on the subject, and though proofs of the utility of trenching and cleaning, and of the loss and disappointment attending a contrary practice are daily and hourly presenting themselves to observation, there are great numbers of gentlemen who, with these proofs before their eyes, still persist in attempting to raise plantations by merely digging holes, and putting in the trees, and then leaving them to take their fate amongst the whins, the fern, or the heath; the weeds or other rubbish with which they are surrounded, and by which the more valuable trees are, in most cases, entirely destroyed in a few years. I will now state as concisely as possible the result of my own experience as to the utility of trenching land previously to planting, and of keeping it clean afterwards.

In the year 1811, I planted a piece of land in this parish containing about five acres, adjoining my house. I call this plantation No. 1. The land had been recently inclosed under an act of parliament, and at the time I planted it, was covered with heath and whins. I caused large holes to be dug, in which I planted Scotch firs, and a proper assortment of deciduous trees. The firs succeeded pretty well, but the other trees made no progress; and, although I yearly filled up the vacancies occasioned by death and decay, I found at the end of four or five years, that all the trees, except the Scotch firs, with very few exceptions, were dead, or in a dying state. I then had all the ground trenched, and the vacancies filled up with oak, ash, chesnut, elm, and other deciduous trees, and have kept it regularly hoed and free from weeds ever since: the consequence has been, that the last mentioned trees have made such a rapid growth that I have been enabled to clear away the greater part of the firs, and the remainder must be taken out in another year or two, to give room for the other trees. One mountain ash, which had escaped the deadly effect of the heath and whins, gave a decided proof of the advantages of trenching and cleaning the land. This tree had barely kept alive, not making more than two or three inches of wood in a year; but in the year following the trenching it threw out two leading shoots, the smallest of which I cut off at Michaelmas, when it measured six feet two inches, the growth of one year.

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[*] From vol. XLV. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce. The society voted its large silver medal to Mr. Withers.

In the spring of 1819, I planted another piece, No. 2, containing about half an acre, adjoining No. 1. This land was trenched two feet deep, and has since been kept perfectly clean; and so great is the advantage of preparing the land properly in the first instance, that the trees on No. 2 are now much superior to those on No. 1, planted eight years before, although the latter have had the benefit of hoeing during the last nine or ten years.

It is worthy of remark, too, that in this last plantation, No. 2, the deciduous trees have far outstripped the Scotch firs in growth; and I believe it is universally the case, that where land is properly prepared and kept clean, deciduous trees will make much more wood than firs, and that where the hole-digging system is adopted (unless the land is very good), the firs are the only trees that will succeed.

The same year in which my plantation, No. 1, was made two pieces of land not a hundred yards distant from mine were planted, one by the late Mr. Richard Gurney, and the other by Mr. Hardy. Mr. Gurney's land was ploughed very deep with a four horse plough; and large holes were dug among the heath in Mr. Hardy's. A good assortment of forest trees were planted in both; but at the expiration of three years, Mr. Hardy, finding many of his trees dead, and the others making little or no progress, trenched his land, and filled up the vacancies, and has since kept it regularly hoed and clean from weeds. Mr. Gurney's has been entirely neglected, and the heath and whins have been suffered to grow to the height of several feet. The consequences are, that Mr. Hardy has at this time a fine flourishing plantation, while in Mr. Gurney's (which is divided from Mr. Hardy's by the road only) all the deciduous trees are dead, and nothing remains but Scotch and larch firs.

A plantation made by Mr. Mott, about half a mile further on towards Cromer, where the land was properly ploughed and planted, but as been neglected since, affords another proof of the necessity of cleaning the land, and keeping it clean. The trees have been declining yearly, and nothing now remains but a few scrubby Scotch firs, although an abundance of other trees was originally planted with them.

Different motives operate on gentlemen to prevent their keeping young plantations clean. Some think it not only unnecessary, but injurious, to the young plants; the weeds, they say, keeping the land moist, and shading the roots of the plants from the heat of the sun, while stirring the ground lets in the drought. Others object to the expense (about sixteen shillings an acre per annum for three years), and almost all, I believe, are apprehensive, that by keeping the land free from weeds, the cover for game would be destroyed.

As to the first of these objections, nothing can be more palpably erroneous. It is well known that nurserymen spare no pains or expense to keep their ground free from weeds, and gardeners invariably do the same, as the most effectual means of promoting the growth of their plants. It must be evident, that every weed which is suffered to grow, must rob the ground of a portion of food which the plants would otherwise receive; and this is a consideration of the utmost importance, when it is remembered that, during the first two or three years of the growth of young trees, they must be principally indebted to the superficial soil for their nourishment; and moreover, land which is suffered to get hard cannot imbibe so much of the atmospheric moisture as it would receive if the surface were kept in an open and loose state by the hoe. It is quite a mistake to suppose that stirring land in dry weather lets in the drought. On the contrary, it is the only effectual means of keeping it in a moist state, the loose mould detached by the hoe operating as a shade upon the soil beneath. Let sand about two inches thick be laid upon a piece of broken ground, and in the hottest weather, moisture will be found below: while the ground adjoining (not shaded by the sand) will, if not pulverised, be hard and dry for nearly a foot in depth; and hoeing produces the same effect as the sand. As to any other shade than that produced by hoeing, the plants want none, and the more powerful the heat of the sun, the faster they will grow, even upon the lightest soils. As to the expense of hoeing, what can be the object of sixteen shillings an acre for three years, compared with the difference in value between fine growing plants of oak, ash, and chesnut, and worthless Scotch firs? Most gentlemen plant for future profit: planting, we all know, cannot be done in the worst manner without expense, and if the extra cost, which insures a profitable crop be spared, the object is entirely defeated, and the money which is expended wholly thrown away. It would be quite as reasonable for a farmer to incur all the cost of preparing his land for turnips, and then to lose his crop, rather than be at the expense of hoeing it, as it is for a gentleman to lay out his money in putting trees into the ground, and then omitting to expend such an additional sum as is absolutely necessary to make them productive.

The objection about game is quite as untenable as the others. I admit that heath and whins will afford better cover than land in a clean state, but this will not last many years under Scotch firs, which, it is well known, will destroy all vegetation beneath them. A good permanent cover is not to be had in a plantation without underwood, and this cannot be made to grow among heath and whins, nor unless the ground be kept perfectly clean. To hoe young plantations is, therefore, not less necessary to obtain a good cover for game, than it is to ensure a profitable crop of timber.

I have hitherto confined my observations to cases in my own neighbourhood; but I could cite numerous other instances even there, as in other parts of the kingdom, of the total failure of plantations for want of trenching and cleaning, and of the success of others where that mode of planting and keeping the land clean has been adopted; indeed, a volume might soon be filled on the subject. The first person, I believe, who introduced the hoe into young plantations in this county was my friend Mr. Sandys, of Wells, next the sea, who began to plant upon the Holkham estate for Mr. Coke, about forty-six years ago, and who has succeeded in raising for that gentleman, and upon a poor soil, nearly one thousand acres of the most flourishing and valuable trees in the kingdom: but I sincerely believe that if these trees had been assisted in their early growth by manure, Mr. Coke's estate would have been worth at least one hundred thousand pounds more than it now is. This may be regarded as a bold assertion, but I am convinced that the estimate is below the mark. These plantations are from twenty-four to forty-six years old, which gives an average of thirty-five years; and if we add only three pounds an acre per annum for that period, for extra growth, in consequence of manure (which is a mere trifle, compared with the actual increase,) it will amount to more than one hundred pounds an acre. From Mr. Sandys I first learnt the necessity of trenching and cleaning land for trees, and the reasons which I have before urged to show that necessity, have been mostly derived from him; and I think it no more than just to offer this testimony to the merit of a gentleman, who is no less distinguished for his ability as a planter, than he is for the taste which he uniformly displays as a landscape gardener, in ornamenting and beautifying gentlemen's estates.

I will now proceed to show the effect of manure upon the growth of forest trees. In the year 1818, I purchased about an acre of land, No. 3, adjoining the plantation, No. 1. This land was originally heath, and was allotted under the act of parliament before-mentioned, but instead of being planted, was cultivated and cropped with corn and other agricultural crops, and when I took it, was in a rich state. I converted the greater part into a garden, and planted about one rood with forest trees, having first trenched the land about two feet deep, and have since kept it thoroughly clean from weeds. These trees are now in the most prosperous state, and, taken altogether, far exceed those adjoining, which were planted seven years before, and are also much better than the plantation, No. 2, which was made without manure, in the year following, making every allowance for the additional growth of one year. Some of the oaks are twenty feet in height, and measure eighteen inches round at the bottom, and the other trees are equally good.

In the same year (1818) I planted several trees in borders well prepared near my house, No. 4, and being intended for ornament and shelter, more than ordinary pains were bestowed upon them. This labour they have amply repaid. There are elms, oaks, and locusts, from nineteen to twenty-eight feet high, and which girt in proportion; while trees of the same description, planted at the same time upon adjoining borders not so well prepared, are not near the size.

In 1820 I purchased some more heath-land near the above-mentioned. I caused the heath or ling to be pared off and burnt in the method recommended by Mr. Cobbett in his "Year's Residence in America;" and in the following year I planted about twelve acres with forest trees. Upon part of this twelve acres, No. 5, I had the flag-ashes spread before the trees were planted, and removed ashes from the remaining part. The first year the trees upon the land where the ashes had been spread, showed a most decided superiority over the trees where the ashes had been removed, No. 6, and the difference has become more manifest every succeeding year. It is now, indeed, so very great, that it is scarcely credible it should have been produced by such a cause only, but such is the fact, the land being precisely of the same quality, treated in every respect in the same way, except as to the ashes, and planted at the same time with the same kinds of trees. The trees on the one part are nine or ten feet high, and so close together, that they must be pruned and thinned considerably this year, while those on the other part are not more than three or four feet in height, and they by no means cover the ground; and I verily believe that the former will be better at ten years old, than the latter will at twenty or twenty-five. In order, however, to enable the society to form their own judgment on the subject, I send specimens of the trees from both parts of the plantation.

Upon another part of the above twelve acres, from which the flag-ashes were removed, No. 7, I spread some marle and brick earth, and the trees there grow quite as vigorously as those which had the benefit of the flag-ashes; and from this circumstance I am convinced that marle or brick earth is very serviceable in promoting the growth of trees upon poor light soils. Specimens of these trees are also sent.

Having thus witnessed the efficacy of manure in the several instances before-mentioned, I determined never to plant another tree without first manuring the ground. In the summer of 1823 I hired some heath-land, No. 8, of the Fishmongers' Company of London, for forty years, under an agreement to plant fifteen acres, having the benefit of the plantation during the term, but leaving the company one hundred trees an acre at the end of it. It was obvious that the faster I could make the trees grow, the better they would pay me, and with the above experience before me, I resolved to manure the land with both marle and dung. I caused the land to be double ploughed, first with two horses, and then with four, following in the same furrow; by which means the soil was stirred to the depth of eighteen or twenty inches. I fortunately found the remains of an old marle-pit in the piece, from which I barrowed and spread twenty cart-loads per acre. This I suffered to lie and pulverise all winter, and in the following spring (viz. in April 1824,) I carried on and spread twenty loads per acre of good rotten dung, ploughed it in, and planted the trees, which consisted of oak, ash, elm, chesnut, and black Italian poplar, with a few of other sorts.

They took exceedingly well, and many of them made vigorous shoots the first summer; the second year they nearly covered the ground; but during this summer their growth has been prodigious; many of the ash trees have made shoots upwards of five feet long; and, upon an average, I think, both they and the oaks have increased this year full three feet in height. The chesnuts have not done so well, but the poplars have made such progress, that they have actually the appearance of trees eight or nine years old. The severe drought which has burnt up trees on land in a poor and foul state, has had the effect of adding considerably to the growth of these. They have never had the appearance of wanting moisture, although not a drop of rain fell upon them for a period of several weeks, during the very hottest part of the summer. This luxuriant growth I attribute to the deep ploughing, to the highly-manured state of the land, and to its being constantly kept clean and loose upon the surface, by means of the hoe: and I firmly believe that when land is in this state, the weather in England can never be too hot for forest trees.

It is necessary to say something about the expense of doing this, as I am aware that an objection would be raised on that ground by almost every gentlemen to whom this mode of planting might be recommended. With the view of exciting attention to the subject, I have put up a board in the plantation by the road-side, enumerating all the particulars, which I will here copy:—

" Experimental plantation, showing the effect of manuring land for forest trees. Planted in April, 1824:

" *Cost per Acre.*	£.	*s.*	*d.*
" 20 loads of marle, at 15*d.* - - -	1	5	0
20 ditto of dung, at 5*s.* - - - - -	5	0	0
Ploughing the land - - - - -	1	0	0
Trees, carriage, and planting - - -	7	10	0
Total cost per acre - - - - - -	14	15	0"

The ploughing I think I have put 10*s.* too low, and therefore the total cost per acre may be stated at 15*l.* 5*s.*

This may and will be thought by many to be a great sum; but a nursery-man will not plant with good trees, and fill up for three years, under 10*l.* an acre, exclusive of ploughing; and observe, that when you manure, you never want to fill up, for all the trees are sure to take, and instead of filling up you may, after the third year, take out and transplant at least a tenth part of them. Look, too, at the rapid manner in which the trees grow, and how much more quickly you get a plantation into a paying state, than you do when trees are planted without manure.

I know hundreds of acres of land, which were planted from fifteen to twenty years ago at an expense of more than 10*l.* an acre, the trees on which would not now be valued at the original cost of planting them, whereas, had one-third more been expended in manuring and properly preparing the land, they would have been worth from 50*l.* to 100*l.* an acre.

A regard to economy in planting is sometimes carried to too great a length. A gentleman (Admiral Windham) about eight miles from me, planted in the same year in which I planted part of No. 8. (1824) forty acres of land upon a cheap plan. Some Scotchmen persuaded him, that neither trenching, nor ploughing, nor cleaning, was necessary; that just to raise a flag, by making a triangular incision, and putting in a seedling plant, and pressing it down with the foot, was quite sufficient to raise in quick time a flourishing and valuable plantation; and that as to the grass and weeds, they would keep the trees warm, and also keep out the drought; they would, in fact, be a source of both heat and moisture; and all this was to be done for 3*l.* 10*s.* an acre. Most gentlemen are disposed to listen to any proposal for doing work cheaply, accordingly the Scotchmen were employed, and planted the forty acres. But the plantation is a total failure; the trees (that is, such of them as are alive) are almost entirely choked with grass and weeds, and are literally worth nothing. The sum of 3*l.* 10*s.* an acre, amounting altogether to 140*l.*, is therefore as completely thrown away as if it had been cast into the sea. Besides the loss of the money, there is the loss of time (which cannot be recovered), the rent of the land, if it were worth any thing, and the mortification of having a favourite object defeated; and to all this gentlemen expose themselves by attempting to effect improvements parsimoniously.

Farmers of poor land generally fall into the same error. They do not perceive, or are unwilling to believe, that it is the trifling expense of a little extra manure, that occasions all the difference upon this sort of land between an abundant and a short crop; but that such is the case I have frequently observed in my own immediate neighbourhood. I have myself grown upon poor heath land nine and ten coombs, and in one instance eleven coombs and two bushels of wheat an acre, while the adjoining lands of the same description and quality have never exceeded six, and this has been effected merely by laying on an additional quantity of eight loads of dung per acre. My neighbour has put on twelve, and I twenty loads per acre; he has grown six coombs, and I have grown ten. It does not appear to be considered, that in high farming the dung is the only additional part of the expense; the tillage, seed-corn, rent, poor-rates, and labour, being the same, whether you grow six coombs or ten. The same observations will apply to trees, which are sure to pay for all the extra cost and labour bestowed upon them.

I cannot conclude without stating a circumstance which exemplifies, in the strongest manner, the power of manure, when applied to a naturally fast-growing tree. I allude to the locust, one of which I planted upon a border in plantation No. 1, in the year 1821, and being intended for ornament, it was planted with manure. In 1824, I cut it down, and in the following year it threw out several shoots, one of which, at the autumn, measured ten feet in height. The following year it increased six feet, and measured six inches round at the bottom; but the upper branch having been blown off, I cut the tree down, and sent it to Mr. Cobbett, at 183, Fleet-street, whom I have requested to send it to the society.

This year I cut down another locust, which was planted with manure, at the same time, upon a soil still worse, one of the shoots from which has grown to the astonishing length of eleven feet. This I have also sent to the society.

The success of a plantation almost entirely depends upon the trees being well set off. On good land this will be the case without any other assistance than trenching and cleaning; but on poor land manure also is necessary. This will enable the plants to strike out numerous and vigorous roots, by which their food is obtained. I am aware that an opinion is entertained, that plants receive a considerable part of their nourishment from the air; but if this be so, it can only be through the medium of their branches and leaves, as being so many channels or vehicles through which that nourishment is conveyed or imbibed; and if manure increases the size and number of these branches and leaves, as it certainly does, it follows that plants are thereby furnished with additional means of obtaining food, it being obvious that a tree with luxuriant branches must possess the power of taking up food from the atmosphere in a much greater degree than a feeble plant, with but little wood and few leaves; and therefore manure is equally beneficial to plants, whether they derive their nourishment partly from the air, or wholly from the soil.

Considering the zeal and expense with which all agricultural improvements have been adopted and pursued, it is rather surprising that gentlemen should have devoted so little of their money and attention to the no less important science of planting, and stimulating the growth of, forest trees; but this lukewarmness may, to a certain extent, be accounted for. Most gentlemen are induced to plant as cheaply as possible, under the impression that they are sinking money for the benefit of their posterity, or that the period of return is so remote and uncertain, that it is scarcely equivalent to the expense they have parsimoniously prevailed on themselves to bestow; but if they could once be convinced, that by a more liberal expenditure they might themselves obtain a speedy and certain return, one of the great obstacles to an improved and profitable mode of planting would be removed, and we might hope to see the country again enriched and embellished, as it evidently was in former times, by forests of oak, and other valuable timber, instead of witnessing, as we now do, innumerable tracts covered with perishable firs, which are worthless, in comparison with other trees, and repulsive to the eye of taste. I am the more inclined to indulge in this anticipation, and to believe that so desirable an event will happen, if the prejudices and opinions which I have alluded to be removed, from the circumstance, that most gentlemen are in the habit of adopting the mode of culture I recommend upon other occasions. No one thinks of planting fruit trees, even in a garden, without manure, and no good farmer attempts to raise a fence upon ordinary land, without manuring it at the time he plants the layer. Fences so raised will make greater progress in one year, than they will in three without manure; and there is no reason why the same stimulus should not prove equally beneficial when applied to forest trees. I hope, however, that some gentlemen, with better means than I possess, will give the experiment a fair trial upon a large scale. It may be difficult in some situations to obtain sufficient manure, and it is therefore deserving of consideration, whether artificial manures will not answer the purpose: I am of opinion that they will; but I intend to try some experiments on the subject in the ensuing season, the result of which I will communicate to the public.

I am, sir, &c.

A. Aikin, *Esq. Sec &c.* W. Withers, Jun.

XIV.—*On Lithography. By Count* M. D. LASTEYRIE, *of Paris.*

(Continued from vol. I. page 290.)

Lithographic Crayons for Drawing on Stone.—It is impossible to obtain beautiful lithographic impressions, if the crayons used by the artist have not the requisite qualities. The ingredients of which they are composed ought to be of such a nature as to adhere firmly to the stone, after the design has undergone the preparation by the acid, as well as during the process of drawing it. They ought to be sufficiently hard to admit of being brought to a very fine point, and to allow the artist to make clear and well defined lines, without the danger of breaking it off. If they are made too dry or porous, they are subject to break very frequently ; if too soft, they crumble, and will only form coarse and confused lines, making it impossible to produce a drawing possessing character and neatness. It would be rendering a great service to lithography to discover the means of forming crayons as hard as those made of black lead, so as to be able to trace, on stone, lines as fine and clear as those made with these pencils. It is, in fact, an improvement which the art yet requires. The following composition, however, is, in the present state of lithography, found to answer the purpose :—

Soap, from suet or tallow—dry - - -	150 parts.
White wax, free from tallow - - - -	150
Lamp-black - - - - - - - - - -	25

The soap and the wax are to be put into a covered skillet on a brisk fire, and when the whole is perfectly melted, the lamp-black is thrown in a little at a time, taking care to stir the mixture continually. The common lamp-black of commerce may answer, without its being necessary to calcine it ; but when, as is sometimes the case, it contains particles of sand or earth, it must be rejected ; it ought also to be extremely fine. The whole should be allowed to boil for a few moments, in order that the mixture may be complete; the composition is then poured into a mould of wood or of brass, which is made to open and shut at pleasure, and in which twenty-five or thirty crayons may be formed at once. It is necessary to rub the mould with oil, to prevent the material sticking to it. After having filled it, it is opened, and the crayons removed; it is then closed again, and fresh matter poured in, which must be kept very hot. A flat plate of metal is sometimes used instead of a mould. it must be made warm to prevent the composition cooling too rapidly, and be surrounded by four ledges of wood, in order that the melted mass may not run over the edges; a quantity is then to be poured in sufficient to make the crayons of a convenient thickness. The pieces of wood are immediately removed, and the material is cut with a knife into such strips as to form crayons of the desired size. It is necessary to be very quick in this operation, that the paste may not have time to cool, for in this case it would break under the knife. The crayons thus cut will separate readily from the plate, if care have been taken to rub it with oil. The formation of air-bubbles is prevented by allowing the boiling to cease for a moment before pouring out the matter, or by pressing it with a stone, or some other body, that has been made warm.

Lithographers submit the materials which they employ in the composition of their crayons, and even their ink, to the action of burning; but this method is, nevertheless, a very bad one, as in the combustion a part of them is entirely destroyed, and it is besides impossible always to obtain with certainty crayons of the same quality. Some persons pretend that it is necessary to use different kinds of crayons during the progress of the drawings; but if the artist have a really good crayon, he will find it answer equally well for every part of his work, or the utmost that can be required is a trifling difference in the degree of hardness given to them, which difference may be effected by increasing or diminishing the quantity of wax in the compound, or by adding to it a little mastic. Another composition has been recommended for crayons called *re-touch crayons*, and which are used for repairing those parts of a drawing which are accidentally detached from the stone during the operation of drawing; but a drayon which is suitable for forming the design in the first instance will serve equally well for these retouches.

Printing Ink.—This ink differs from that used in typography, in being much thicker. In order to form it, a varnish is made of linseed or nut oil, with which is ground up a certain quantity of lamp-black. The older the oil is the better is the varnish. This ink should not be too thin or liquid, nor must it be too strong or thick. If, when mixed with the lamp-black, it be found to possess the first fault, it will extend itself beyond the lines and points which form the drawing, and be widened still more by the action of the roller or of the press in obtaining the impressions, and in the end would adhere to the stone, or fill the spaces between the lines, notwithstanding the water used to prevent these effects; it will also the more readily be imbibed by those parts of the stone which have not been covered by the crayons or the ink used in drawing, which will also be softened, and the harmony of the design destroyed. If it be too thick, if the lamp-black be not well incorporated, or any heterogeneous substances be mixed therewith, it will not take well on the delicate points and lines—it will be apt to break them up, or choke the spaces between them and unite them together, as they will be liable to crush by the force used in taking the impressions.

The same means are used in making this varnish as are employed in preparing that which is used for letter-press, that is in an iron or a copper vessel a quantity of oil is poured, sufficient for the varnish it is desired to make, taking care that the vessel is not more than two-thirds filled. This precaution is indispensably necessary, in order to prevent those accidents which might occur from the oil boiling over. Even in this situation it may suddenly swell up and boil over—it must, therefore, be carefully watched, and when necessary removed quickly from the fire, or it would inflame, to the imminent danger of every one exposed to its action. When the vessel is thus removed it is generally placed in a hole prepared in the ground, that it may be more quickly cooled. This preparation should be made out of doors, and in a place where no damage can ensue from such an accident. When the oil is boiled in a fire-place, there should be close at hand a heap of ashes ready to throw on the fire to deaden it. Some persons put litharge into the oil to render it drying, but ink which has been thus prepared hardens too quickly upon the inking stone and roller; its tenacity will also cause it to adhere too firmly upon the drawing, and may consequently detach its more delicate parts. In preparing the oil a few pieces of bread are successively thrown into it whilst it is boiling, and these are removed when they assume a brown colour; onions are occasionally used for the same purpose. The advantage in this proceeding is, however, very doubtful.

The oil requires five or six hours boiling, and even more when there is a great quantity of it. When it begins to boil the evaporation is accelerated by stirring it, and lading and pouring it back into the vessel with an iron ladle, furnished with a long handle. A lid is at first placed on the vessel to hasten the heating of the oil. The oil is to be inflamed at three or four different times, taking care to extinguish it when it burns too fiercely: this may be done by blowing upon it, by placing the cover upon the vessel, and if necessary by removing it from the fire. The fire is applied to the oil by means of a piece of flaming wood or paper, which is brought near to its surface, if the liquld does not take fire it is a proof that it is not yet sufficiently heated. The oil is to be laded up, and poured back again whilst it is burning. All these operations should be performed with great care to avoid injury from the fire, and more particularly from the boiling oil, which burns severely wherever it touches.

In order to ascertain when the oil is boiled enough, and the varnish has acquired the requisite degree of consistence, a few drops are allowed to cool on a piece of glass or on a plate. When the varnish has been allowed to cool, it ought not to be capable of flowing on the body on which it has been placed; when touched by the finger, it ought on raising it to draw out into long threads, and the length of these threads indicates the thickness of the varnish. The consistence of the thinnest varnish should be a little less than that of common honey, but experience alone can teach the exact degree of thickness which is necessary. For lithography two kinds of varnish are in general prepared, one thick, intended for crayon drawings, the other thinner, for designs in ink; and when it is desired to have one of an intermediate quality, these two are mixed together. These varnishes may be kept in the vessels in which they were made, or in glazed jars, care being taken to cover them closely. If the varnish has been boiled until it is too thick, it may be made thinner when necessary by warming it a little, and mixing with it a certain quantity of linseed oil. It may also be tempered without heating it by rubbing it up with a little oil, observing that only a very small quantity must be used, otherwise it will spread on the impressions and thus spoil them. A quantity of this varnish, sufficient for a fortnight's work, is taken, and in small portions at a time ground up with lamp-black by means of a mullar, carefully observing to cover it whenever any is taken out for use. The varnish may be thickened by adding to it a greater quantity of lamp-black.

In order to obtain beautiful drawings, a black of the best quality must be used; the lamp-black found in the shops is greasy, and of a brownish colour, and if employed will produce impressions which will appear dull and rusty. To avoid this inconvenience, that black should be used which is made of burnt, or rather, carbonized rosin. It is prepared by packing it closely in a crucible, the lid of which is to be luted down with potters' clay; the crucible is then placed in a stove, and covered with lighted charcoal, and thus left until no smoke can be perceived to issue from the interstices around the cover. This black, when taken from the crucible, presents a body sufficiently hard, but friable; it is to be broken on a stone, and pulverized with a mullar, before mixing it with the varnish. Some persons mix with the lamp-black a small quantity of indigo to give more tone to the proofs: this, however, is not necessary when the lamp-black is of the first quality.

The public taste sometimes requires that prints or designs should be produced in colours. In this case the colour required is mixed with common varnish. Those which combine with this varnish are for blues, indigo, and Prussian blue, and for reds, vermilion, and carmine; this last colour requires to be rubbed up with spirits of turpentine to enable it to incorporate perfectly with the varnish. The ochres when they are very fine may be used for reds or yellows, and that of the latter colour, when mixed with indigo, will produce a green. Terra di Sienna gives a brown, &c. The greater number of colours, as they are found in the shops, not being sufficiently free from grit or other gross particles to produce good ink, it becomes necessary to mix them in fine powder with a certain portion of water, in which the grosser matter is allowed to subside, and which is then decanted, and left at rest to deposit the washed colour.

Preserving Ink.—When a stone has been drawn on, all those parts which constitute the design are covered with a thin coat of printing ink; but this ink, being very siccative in its nature, dries after a certain time, and then takes with difficulty, or entirely refuses to receive the ink with which it must be charged for the purpose of obtaining a new impression. This inconvenience is but little felt in ink drawings, it being only necessary to cover these with a coat of gum to preserve them for a great length of time. It is not so, however, with drawings executed in crayons, or with those which are engraved, or with stones intended to produce coloured impressions. These are soon deteriorated, although defended by a coat of gum; they require to be protected by an ink which will always retain its unctuosity. The two following compounds have been found to succeed equally well:—

Lithographic varnish, very thick	2 parts.
Mutton suet	4
White wax	1
Oil of turpentine	1
Lamp-black	4

The three first articles are to be melted over a slow fire, when the oil of turpentine is poured in, mixing the whole well together; then is added the lamp-black, a little at a time, stirring the mixture until it is formed into a homogeneous paste. The other composition consists of

White wax	1 part.
Suet	2
Oil of turpentine	as much of each as is necessary to give a colour and consistency similar to that of common printing ink.
Lamb-black	

These inks should be kept in a covered vessel, to preserve them from the dust and air. An inking stone and roller must be appropriated exclusively to their use. The ink is spread over the stone with a roller, and after having taken an impression of the drawing, it is well cleaned with a damp sponge; it is then charged with the roller, as it would be were another impression wanted, and the stone is then covered with gum water.

In Germany, these precautions are carried to a greater extent. When no more impressions are wanted, and the stone is to be put by for future use, the design is removed frum the surface by spirits of turpentine, the stone is cleaned by washing it with water, then inked in the way just described, and then lightly coated with gum-water. Before the stone is so disposed of any spots or blotches which may be found upon the drawings are carefully removed.

When the stone is wanted for new impressions, the gum is first removed by water and a sponge, the preserving ink is cleaned off by a sponge and spirits of turpentine, the stone is then moistened and charged with the ordinary printing ink by means of the roller.

Retouching Ink.—It sometimes happens, particularly in designs made with the pen, that the ink with which they are drawn has penetrated the stone but slightly. In this case, as the printing ink, which is applied to the roller, does not adhere sufficiently to the slight drawing made upon the stone, an ink is used, called by the Germans *Anneme farbe,* and which unites with and penetrates more deeply into the traces made so superficially on the stone. This ink is composed of equal parts of linseed oil, suet, and soap, half the quantity of wax, and a little lamp-black ; the whole is melted and mixed well together, and oil of turpentine added to it, when it is desired to make it more liquid. After having prepared the stone and covered it with gum water, a little of this ink is taken, and by means of a clean linen cloth rubbed lightly over every part of the writing or drawing, taking care that it does not cover those places on the stone which are intended to remain white. The gum-water does not prevent the ink adhering to the lines of the drawing, but it does not allow it to stick to those parts which are not covered by the lithographic ink with which the designs are made. If, notwithstanding this, parts of the stone become blackened, the spots are removed by pressing on them with the end of the finger or the palm of the hand, which has been previously dipped in strong gum water. The stone is washed with one sponge, and wiped lightly with another—it is then inked with the roller, and the impression taken.

(To be continued.)

XV.—*On the Preparation of a cheap Soda Liquor, without Crystallizing the Soda, for the use of the Turkey-red Dyers.* *By Mr.* CHARLES CAMERON*.

SIR, *No.* 18, *Salt Market-street, Glasgow, April* 7, 1827.

I BEG leave to request of you to lay before the committee the following communication: I hope it is not yet too late. You, sir, as a man of science, will immediately appreciate its merit.

I am, sir, &c.

A. AIKIN, *Esq. Sec.* CHARLES CAMERON, *Chemist.*

Method of making a cheap Soda Liquor, without Crystallizing, for the use of the Turkey-red Dyers.—As the Turkey-red dyers are the great consumers of the common soda of commerce, it occurred to me, about four months ago, that they might make their own alkali, by the cheap and simple process of decomposing muriate of soda by pearl-ash, and thus procure a liquor equally pure, without the tedious and expensive operation of bringing the soda to the state of crystal. I pointed out the following plan to a Turkey-red dyer here, who immediately put it in practice, and it is now gradually adopted by the trade.

Into a cast-iron boiler capable of holding four hundred and fifty gallons of water, I put ten hundred weight of pearl-ash (first sort), seven hundred weight muriate of soda, and four times the weight of the muriate of soda of water, applying heat, and stirring until both are dissolved. After boiling for some time, the muriate of potash begins to crystallize on the surface. As the boiling is still continued, the muriate of potash is rapidly forming, and is lifted out of the vessel by means of a ladle pierced with small holes, and is thrown into a vessel placed in an inclined position, with its end or side a little within the edge of the boiler, which allows any of the liquor that may have been carried over to drain back again into the pot. The boiling is continued until nearly the whole of the muriate of potash is deposited and taken out. The liquid is then removed into another vessel, either of cast iron or wood lined with lead, and allowed to remain until it has cooled to the temperature of sixty degrees, during which time it parts with the rest of its muriate; it is then run off into another vessel, and diluted with water to twenty degrees specific gravity, more or less at pleasure, which prevents the soda from crystallizing, and gives an uniform strength of liquor, equally pure with the best crystallized soda, and at about half the price. The above weight of pearl-ash and muriate of soda produces a mineral alkali equivalent in quantity to what is contained in one ton of soda of commerce, the best of which does not exceed 22 per cent.

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* From vol. XLV. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

Present price of soda, 22*l.* per ton.

	£.	*s.*	*d.*
Price of pearl-ash, first sort, per ton	28	0	0
14 cwt. of muriate of soda, 30*s.* per ton	1	2	0
	29	2	0
These produce 1¼ tons of muriate of potash, price 5*l.* 10*s.* .	6	17	6
Cost of alkali, equivalent to 2 tons of soda	22	4	6

The process is so simple, that one workman can decompose one or more tons per day, dependent on the size of his vessels. As the Turkey-red work consumes from forty to two hundred and fifty tons annually, according to the extent of its establishment, it is of great importance to that valuable manufacture. I can claim no merit in merely decomposing muriate of soda by potash, that is a fact long known; what properly belongs to me is, being the first to point out to the trade a simple and unexpensive method of making their own alkali, without being at the expense of erecting additional premises, and extensive apparatus, required for the purpose of crystallizing; a common boiler and two or three other vessels being all that is requisite.

CHARLES CAMERON.

XVI.—*On the Preparation of Vegetable Extracts for Medicinal Use, without the aid of Artificial Heat. By Mr.* J. HOULTON, *F. L. S.*[*]

SIR, 11, *Grove-place, Lisson-grove, March* 25, 1827.

I BEG to solicit the attention of the Society of Arts to specimens of extracts of medicinal plants, which have been prepared without the aid of artificial heat, and in a more easy and economical method than that ordinarily employed, and which, at the some time, produces an article in no respect inferior to the extracts made in the usual way, but in many points very superior; and it ensures the preservation of the smell, flavour, and full medicinal power of the plant from which it is prepared; and, with care, the colour may be preserved in a very superior manner.

The process is not so liable to failure as the common way; in fact, failure to make a superior article is almost impossible.

No. 1. A dry extract of taraxacum.

No. 2. Extract of conium.

No. 3. Extract of conium in a dry state, to show the resinous fracture.

No. 4. Specimen of vegetable extract (*conium*), in which attention has been paid to colour.

Should the society deem the manufacture worthy their notice, I shall be happy to lay before them a fuller account of the process I adopt.

I am sir, &c.

A. AIKIN, *Esq. Sec.* JOSEPH HOULTON, F. L. S.

Member of the Royal College of Surgeons.

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[*] From vol. XLV. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

It is well known to professional men, that the juices of almost all plants are more or less injured in their medicinal qualities, by being boiled down and evaporated in the usual way, to the consistence of extract.

At Apothecaries' Hall the evaporation is entirely effected by means of steam, so that the heat employed is under complete control; and in Mr. Barry's patent process, the evaporation is performed in vacuo.

Mr. Houlton's process is the following: the plant being bruised, is to be submitted to the action of a press, in order to squeeze out the juice, which is then to be strained through fine linen. The depurated juice is now to be poured to the depth of about one-eighth of an inch into an earthenware plate, or a glass dish, and is to be exposed to a constant current of air, by placing it on the inner sill of a window, and raising the sash about an inch. The constant current of air thus produced, occasions the rapid evaporation of the watery parts, and there remains a soft extract, retaining the colour, odour, and medical properties of the recent plant, with less alteration than by any other method. If the sun shines, a blind should be hung before the window, as vegetable juices are speedily changed by the action of solar light. The consistence given to the extract is entirely optional, but those that are rather hard will keep better than those that are soft.

The method is not adapted to a manufactory on a large scale; but any individual practitioner may, without much trouble or expense, prepare in this way, for his own use, extracts far superior, in active properties, to those that are usually met with.

XVII.—*On Preserving Lime Juice for Sea Voyages, without the use of Rum. By Captain* WILLIAM BAGNOLD*.

SIR, *Falmouth, July* 12, 1825.

FROM some conversation I had with one or two of the members of the transport board, I find they are by no means satisfied with their knowledge of the effect produced on the antiscorbutic qualities of lime-juice, by the 25 per cent. of rum, now added for its preservation. This induces me to hope, that the mode I have adopted to cure it for sea voyages may be of more consequence than I at first suspected. Last Christmas I caused some to be prepared in Jamaica, and one dozen has been sent home, samples of which will accompany this letter. I have simplified the process, and I trust where the directions are carefully followed, the juice will be permanently preserved in an unaltered state. The bottle which accompanies this, is one of a dozen, prepared by a process far less troublesome, and equally efficacious, with that of M. Appert, for the application of which I had the honour of the society's thanks last year; and by the alteration proposed, a great deal of the loss hitherto occasioned by the bursting of bottles in the boiler will be prevented. Should the society be of opinion that I have made an improvement in the process, they will deal with it according to its merits.

The expressed juice being well strained, to separate every particle of pulp and rind, is to be boiled in an earthen vessel smartly for half an hour; a part of the water is driven off, and the vegetable albumen will separate, and subside on cooling; decant the juice clean, and reboil it for a few minutes; fill it into bottles previously dried and heated, so as to leave just room enough for the cork; cork tight, cement over the cork, and lay the bottles dressing and preparing woollen yarns, and in cleansing, dressing, and finishing woollen cloths, and other fabrics, and in the apparatus for performing the same. Dated Jan. 15, 1828.—In six months.

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* From vol. XLV. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

To Thomas James Falconer Atlee, of Prospect-place, Deptford, in the county of Kent, gent.; for certain improvements in bands or hoops, for securing made and other masts, bowsprits, and yards, which are also applicable to other purposes. Dated Jan. 15, 1828.—In six months.

To William Erskine Cochrane, of Regent-street, in the county of Middlesex, esq.; for improvements in certain apparatus for cooling and other purposes. Dated Jan. 15. 1828.—In six months.

To Joshua Taylor Beale, of Church-lane, Whitechapel, in the county of Middlesex, engineer, and George Richardson Porter, of Old Broad-street, in the city of London, merchant; for a new mode of communicating heat for various purposes. Dated Jan. 19, 1828.—In six months.

To William Percivall, of Knightsbridge, in the county of Middlesex, veterinary surgeon; for improvements in the construction and application of shoes without nails, to the feet of horses and certain other animals. Dated Jan. 19, 1828.—In six months.

To George Jackson, of St. Andrew, in the city of Dublin, attorney-at-law; for certain improvements in machinery for propelling boats and other vessels, which improvements are also applicable to water-wheels and other purposes. Dated Jan. 19, 1828.—In six months.

GILL'S
TECHNOLOGICAL REPOSITORY.

XVIII.—*On an improved Syphon and Pump for Draining Quarries, &c. Invented by Mr.* R. COWEN*.

WITH A PLATE.

SIR, *Carlisle, April* 21, 1827.

IN submitting to the Society of Arts, &c. a communication on an instrument in such general use, and so well known as the syphon, I would particularly draw the attention of the committee to the fact, that though the theory of the syphon is universally understood, yet it has not been applied in practice for raising water over the highest levels, which the law of the atmospheric pressure and theory have assigned to it. On the common principle, I believe from twelve to fourteen feet rise has been the extent attainable in the practical uses of the syphon, although the weight of the atmosphere, at its lowest point of pressure, is an equipoize to a column of water of thirty-two feet in height. If a syphon of any height be filled with water, it may in theory be considered a torricellian vacuum; and it is only necessary to shorten one of the legs below the height of a column of water equal to the weight of the atmosphere, to give the other a preponderance, and the water begins to flow from the longer leg, and in theory should continue to do so. Water, however, has an affinity for air and some of the gases, and when exposed to them under the pressure of the atmosphere, absorbs a portion of each. This affinity, I believe, may be considered a given force; it is destroyed by boiling, and the air is expelled; it is also diminished as the atmospheric pressure is removed, and a portion of air is set free at something less than half the weight of the atmospheric column. The weight of the opposing columns of water suspended in the two legs of the syphon, it is evident, must diminish the atmospheric pressure, at the highest bend, in an inverse ratio to the height of the shorter leg or column; when this exceeds twelve to fourteen feet, air is set free, displaces the water at the highest bend of the syphon, thus dividing the two columns, and entirely preventing that continuous flow which would otherwise take place were water to contain no gas or air. To devise means to remove this defect in the action of the syphon at the higher levels, is the object of the invention which I now submit to you.

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* From vol. XLV. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce. The society voted the gold Vulcan medal to Mr. Cowen for this valuable invention.

I am, sir, &c.

A. Aikin, *Esq. Sec.* Robert Cowen.

Reference to the Engraving.—Plate III.

Fig. 1, *a a*, part of the quarry to be drained; *b*, a level lower than the bottom of the quarry, which in this case is two hundred yards off, where the water is to be discharged; *c*, the highest ground, over which the water is to be conducted; *d*, *e*, and *f*, three different rises, over which the pipes pass—they are farther apart than here shown; *g g h h*, the lead pipe composing the two legs of the syphon; *i*, a forcing-pump, on the common principle fixed below the surface of the water, having a hinged valve at *j*, fig. 2, and an open working-box with a similar valve *k*. The two valves *j* and *k*, when the syphon is in action, are opened by the force of the water flowing through the pump in its passage to the syphon; *l* is the handle or lever for working the pump, which is placed at a convenient height above the water at all times; *m* is a close iron receiver, shown larger in fig. 3, having inserted at one end, at the lower side, at *n*, the shorter or ascending leg of the syphon *g g*, and at the other end, at *o*, the longer or descending leg *h h*; at the upper side at both ends are inserted two air pipes *p p*, which may be small, joining with the syphon pipe at the highest bends, as shown at *d*, *e*, and *f*, with a regular slope into the receiver to allow the air to ascend into it, which would otherwise remain at the highest elevations of the pipe; *q* is a small valve fixed at the highest point of the receiver, to allow the whole of the air to escape through the valve when the water is forced up by the pump; for this purpose the pump *i* and pipe *g* must be able to supply water quicker than the pipe *h* will carry it off.

To put the syphon into action, it is only necessary to pump the water into the receiver, to expel the air through the valve, and also through the longer leg of the syphon. The syphon will then continue in action without aid till the receiver is again filled with air, which is again expelled by a few strokes of the pump, and only requires to be repeated every twelve hours, when the rise exceeds from twelve to fourteen feet, varying with the unequal pressure of the atmosphere; but when less than the above height, it continues to flow without intermission for any given time, and acts on the principle of the common syphon.

The following are Directions to be observed in laying the Syphon to suit different situations.

1st. In laying the pipes of the syphon, it is necessary to give them a regular slope to admit the air to pass forwards into the receiver, or to the highest bends, which must have either an air receiver to each bend, or a pipe inserted to convey the air into a general receiver.

2d. When sufficient descent from both sides of the air receiver can be obtained, no air pipes will be required.

3d. In situations where it may be necessary to carry the pipes over more than one elevation, and the second exceeds the height of the first, a separate receiver will be required for each elevation. On this construction, viz. with more than one receiver, it is necessary to adopt the following expedient for closing the valves in succession, as the air is expelled from each receiver.

Description to Figs. 4 *and* 5.

Fig. 4; *r* is the lower valve in the receiver *s*, which is opened by the force produced by pumping, and the air escapes; *t* is an inverted valve, with a float or buoy *v* fixed upon the valve-spindle in the centre of the cup *u*. While air only is expelled, the inverted valve will remain open; but when the water is forced out and fills the cup, the float will rise and close the valve at the same time; thus the water being stopped from flowing out, will be forced forward to any number of receivers in succession; *w* is a very small outlet-pipe inserted into the bottom of the cup *u*, through which the water escapes slowly; as the cup is emptied, the float is lowered, and the inverted valve again opened—a position necessary to allow the air to escape at the next pumping.

Another method described for closing the Valve.

Fig. 5; *q* is a valve placed in a cup, as shown in fig. 1; on the cup is mounted a lever with a counter-weight *x* at one end, and a small pendant receiver *y* at the opposite end; *z* is a conducting tube inserted into the edge of the cup, to convey the overflowing water into the receiver, which as it fills loads the valve, and prevents the escape of the water, and thus forces it forward as before described to any number of receivers. At it may be expected that the first cistern will collect the greatest portion or nearly the whole of the air, the others following in succession, may be proportionally smaller.

In making the joints of the lead pipes, I used tinned copper hoops, and made the joints square or jump joints, and soldered them over in the common manner*. The joints of the air cistern were made with iron cement, with a portion of red lead in powder added, and mixed up with oil, in place of water, as in the usual way, and caulked into the joint in the same manner as common iron cement.

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* Fig. 6 represents this excellent mode of making the joints.—EDITOR.

SIR, *Carlisle, Currock Cotton Works, April 27*, 1827.

I beg leave to trouble you with a few observations, in addition to the communication on the improved syphon which I recently had the honour of submitting to the Society of Arts; and I would observe, in the first place, that in my former communication I have designated the air vessel an air cistern, but in the following remarks I have substituted what I conceive to be a more appropriate term —that of air receiver, an alteration I should wish to have made in the original paper and in the section.

On referring to the plan, it will be observed that the water delivered by the syphon passes through the air receiver, and must of course rest there a given time, or in proportion to the quantity of water in the receiver, compared with the quantity discharged, and the time will consequently vary from a quarter to half an hour. This rest is necessary to allow the air to separate—as the affinity between air and water increases as the quantity of air held in solution diminishes, and *vice versâ*, and time is also required in addition to diminished pressure, to effect a complete separation. When the water has not had sufficient time to rest in the receiver, air bubbles collect in the descending leg of the syphon, and diminish the quantity of water discharged materially.

In the first experiment I had a small receiver with a screwed plug or cap at the top, attached to the highest elevation of the syphon, and an inch pipe, having a stopcock introduced between the syphon and the receiver, for cutting off the communication, to ascertain the quantity of air collected in a given time. When the syphon, under this arrangement, had been in operation a short time, the discharge gradually diminished, and in three hours nearly ceased. The two legs of the syphon were now plugged up, and the connexion cut off by means of the stop-cock, the cap unscrewed, and the quantity of air then in the receiver ascertained. The cap and stop-cock were again adjusted, and the descending or longer leg of the syphon shaken a little from the lower end upwards to the receiver. The stop-cock being again closed, and the receiver examined as before, it was found to contain a considerable additional quantity of air, and the water had consequently descended into the pipe and occupied the space, proving, I think pretty satisfactorily, the three following facts: first, that air had separated from the water flowing through the pipe; second, that it had not been carried forward, but had attached itself to the interior of the pipe, in small bubbles; third, and that air bubbles so attached increased the friction to such a degree, as nearly to prevent the discharge. This experiment was repeated with some little variation, and the first result confirmed. The size of the large air receiver was now determined, which I must remark was intended to be double the present size; and I had in the first instance two vessels connected together, but one of them on trial proving defective was detached, and the single one only used. This discharge, however, after twelve hours running, diminishes about one eighth to one tenth in quantity; but for several hours no apparent diminution takes place. Hence the necessity of allowing time for the water to rest in the receiver, by keeping a sufficient quantity in it, and of having the receiver of large capacity, compared with the size of the pipe.

It may also be necessary to observe, that the syphon was in full operation upwards of three weeks, without requiring any air to be forced out by the pump, no air for that period having collected in the receiver. This, however, occurred under the following peculiar circumstances: —on the 3d and 4th of March, a very extraordinary quantity of snow fell, accompanied with a high wind, which drifted the snow into the quarry nearly to the summit; and for several days a rapid thaw, with a fall of rain, succeeded, which, together, filled the quarry with water to an unusual height, so as to reduce the column of water in the shorter or ascending leg of the syphon to 8·5 or 9 feet. After this period, the syphon required no pumping till the column had reached fourteen feet, exceeding the height at the first commencement fully two feet, at which elevation air collected in the receiver, and it required pumping out night and morning. The barometric column, however, at the former period, stood at about one inch and a quarter lower than it did in the latter, which would make some difference, and should be taken into account; but it does not satisfactorily explain the whole difference, which would, in all probability, exceed two feet, as the syphon collected air from the commencement of the first trial, and the minimum of pressure at which air might have then separated could not be ascertained. It is not therefore certain that twelve feet is the minimum height at which air is set free, when the water is fully saturated. It is probable, under such circumstances, at a much lower pressure, as the above is a single instance in which the syphon operated for so long a period without pumping, and the only one with a mixture of snow-water. We have the authority of a number of eminent chemists (with the exception of Gay Lussac and Humboldt), for supposing, that the water obtained from melted snow contains little or no air; and if the law of absorption be correct as established by Dr. Henry and Mr. Dalton, that water will hold in solution a quantity proportionate to the pressure, or if it absorbs one twenty-fifth under the pressure of one atmosphere, two twenth-fifths under the pressure of two, &c.; the same law will hold in diminishing it below the pressure of one atmosphere to that of a vacuum; so that we might presume that in a syphon, where water is fully saturated, air would separate at a much lower pressure; yet, whether it is that water is seldom fully saturated, or that the air is carried forward when it passes rapidly through the syphon, as is the case with a short one having a considesrable fall in the longer leg, I shall not presume to determine, but, in practice, it does not collect under such circumstances in a common syphon of the moderate height of five or six feet. A little more experience, therefore, and repeated observation, are necessary to determine the minimum height at which air will separate from water, and this will unquestionably vary with the proportion of air held in solution, with temperature, with the length of the syphon and the velocity of the water passing through it, and other circumstances.

I am, sir, &c.

A. Aikin, *Esq. Sec.* Robert Cowen.

CERTIFICATES.

SIR, *Howrig, near Carlisle, April* 21, 1827.

Having had under my direction the improved syphon constructed by Mr. Cowen, for draining the stone quarry at Howrig, and being also acquainted previously with the great labour, expense, and difficulties, at certain seasons, in clearing away the water by the common pump, I can with great confidence give my testimony of its having fully answered the intended purpose. It is now comparatively managed with little or no trouble or expense, and by its regular unceasing operations, greatly contributes to the profitable working of the quarry.

The diameter of the pipe is only one inch, and it delivers, on an average, about 3,000 gallons of water per twenty-four hours. When the surface of water exceeds from twelve to fourteen feet below the bottom of the air cistern, a quantity of air collects, which requires to be displaced by a few strokes of the pump night and morning, but does not exceed, in the expanded state, more than from six to ten cubic feet. A few minutes each day are sufficient to expel the air, and the labour is so simple and easily performed, that any of the boys are equal to the task. It may be necessary to observe, that no air can possibly enter through the pump, it being completely immerged under the surface of the water; and that portion of the pipe which was at the surface of the water when the air began to collect, has been accurately examined, but no defect can be discovered, as no water issues from any part of it, even when the force of the pump is applied. I have great pleasure in being able to state, from considerable experience, the superiority of this method of draining such quarries, and am of opinion it is the most economical ever yet discovered, and may be applied for draining other quarries in this neighbourhood, or to any purpose or situation where sufficient fall can be obtained.

I am, sir, &c.

A. Aikin, *Esq., Sec.* William Wood.

SIR, *Carlisle, April* 18, 1827.

I have much pleasure in bearing testimony to the ingenuity and usefulness of Mr. Cowen's improved syphon. I lately accompanied Mr. Cowen and Mr. Studholme to Howrig, and examined the syphon, which was then in full operation, and appeared to answer effectually the purpose for which it was intended.

I am, sir, &c.

A. Aikin, *Esq. Sec.* Thomas Barnes, M.D.

SIR, *Kingmoor House, near Carlisle, April* 26, 1827.

I have examined Mr. Robert Cowen's improved syphon, at present drawing water from a freestone quarry at Howrig, near Carlisle, which appears perfectly to answer the intended purpose.

I took levels and such dimensions as enabled me to draw a correct plan and section, showing the height which the syphon draws the water, and the lengths of its respective parts, which I suppose Mr. Cowen will send you.

I am, sir, &c.

A. Aikin, *Esq. Sec.* John Studholme.

XIX.—*On the Microscope. By the* EDITOR.

WITH FIGURES.

(*Continued from page* 99.)

On the Tabanus, or Horse-stinger Fly.—The Editor, since writing the last article on the subject of the microscope, has been favoured by Mr. T. Carpenter with another invitation to his house, and had the gratification of again witnessing his admirable display of objects, both opaque and transparent, as viewed in his compound microscope. He is not content with possessing a beautifully and scientifically arranged collection of insects, which may be seen in other collector's hands, but he likewise displays any curious parts of their structure, by arranging them as objects for his microscope, always ready at hand, and thus possessing additional means of gratifying himself and his friends, which are greatly beyond the ability of the mere collector of insects to afford.

He has thus displayed the wonderful apparatus employed by the *Tabanus,* or horse-stinger fly, in two opaque objects, as well as between two slips of glass, as transparent objects, and both collectively and separately. By this it appears, that the editor, in his former enumeration of the different parts of this apparatus, had overlooked the proboscis, which is a straight-pointed two-edged instrument, having a groove in its middle, in which the knives and saws are lodged, when the incision is made by the point, and which is afterwards widened by the action of the two knives and the two saws, and the apparatus thus consists of seven, instead of six parts, as before enumerated.

On the Fangs, Eyes, and Thread of the large Garden Spider.—Mr. Carpenter has displayed the fangs and eyes of this insect as a transparent object between the two slips of glass, and its thread carefully preserved across and between two others. We have ourselves the fangs and eyes, as displayed in the exuviæ or cast off skin of this insect, amongst our own collection of objects for the microscope, but we never before saw its thread displayed as a microscopic object. The thread is composed of five threads ejected from as many nipples, with which the spider is furnished, and which instantly agglutinate together on their emission. They preserved a most perfect parallelism amongst each other throughout their whole length across the slider, and thus constitute the best and most equal threads hitherto known for the important purposes they are applied to; namely, the construction of micrometers for astronomical telescopes, microscopes, &c.

On the Eyes and Legs of the Shepherd Spider.—Dr. Robert Hooke, in his *Micrographia*, has given views of the head and two eyes of the long-legged or shepherd spider, which are, indeed, most curiously formed, the head rising out of the middle of the top of its back, mounted upon a neck, and its eyes placed on each side of its head, and looking rather forwards.

Dr. Hooke also mentions its eight extremely long and slender legs, wherewith it strides at a great rate over the grass and herbs; he states, however, that its legs are jointed like those of a crab: had he said like the tail of a monkey he would have been more accurate, for, indeed, such is the case, as appears in one of them, which Mr. Carpenter has made a transparent microscopic object of, and in which it is seen that towards its outward extremity it is furnished with a great number of short joints, whereby it becomes capable of curling round any small body just like the tail of the monkey.

On the Apparatus employed by the Female Cynips in laying its Eggs.—Additional Particulars.—We mentioned in our last article on the microscope, that the female cynips, in the possession of Mr. Philip Carpenter, and which was furnished to him by Mr. Thomas Carpenter, had "an apparatus attached to the hinder part of its body, consisting of the two parts of a sheath, between which is ordinarily placed a slender tube, having its end triply cleft, and whose office is to convey the eggs into the punctures made by the insect for receiving them."

This description strictly accords with the appearance of the insect in Mr. Philip Carpenter's possession, but Mr. T. Carpenter has pursued the investigation of this apparatus to that degree, that he has succeeded in nearly separating the cleft in the tube throughout its whole length, and has thus discovered, by highly magnifying powers, that it is, in fact, composed of a saw, with three teeth, very distinctly marked, and two knives.

The cynips in Mr. P. Carpenter's possession has a most splendid irridescent appearance over its body, legs, &c. and so likewise has several of those which Mr. T. Carpenter bred at the same time with that. Others of them, however, want that irridescency, they being entirely black.

On the Saws and Rasps of the Saw-fly.—Mr. T. Carpenter has several of these curious instruments beautifully displayed as transparent objects between slips of glass, and which completely justify Kirby, in his Entomological work, in saying that they act both as saws and rasps in cutting off portions of the leaves of plants, the teeth in the edges of the two saws being most accurately formed in one of the specimens preserved by Mr. Carpenter, and which appears to be an insect caught before it had an opportunity of blunting its teeth in using them, as was the case with most of the others, and the sides of the saws being furrowed or toothed in the manner of a rasp or file. One of the saws was, besides, divided into two different parts, the back, which inclosed the thin blade of the saw within it, having parted from the blade, which was also preserved entire: so that this wonderful apparatus actually consists of a pair of saws, toothed upon their edges, furrowed upon their sides, and strengthened on their backs, and, in fact, just like the back-saws, toothed also on their sides, to free them in their action, which the Editor had formerly seen in the hands of an excellent workman in the table clock-making line.

The office of this apparatus is to effect the separation of the upper and under skins of rose-tree leaves, between which the insect deposits its eggs.

On the Diticus Circumflexus, or large Water Beetle and its Larva.—Mr. T. Carpenter showed the Editor a highly magnified view of the interesting and curious appendages affixed to the fore feet of this beetle, whereby it is enabled to affix itself firmly to any object. These appendages consist of two circular discs, upon each of which are posited two other circular discs, they being attached to the larger discs at their centres only, and having radii lines proceeding from their centres to their peripheries, by means of which it would seem that the insect has the power of elevating the centres of these secondary discs, and thus producing, as it were, a sucking action upon the body to which they are to be affixed, exactly similar to that of the circular pieces of leather, with strings in their centres, which, when wetted, boys are in the habit of affixing to stones, and thus lifting and carrying them. Besides these two pairs of secondary circular discs, the remaining parts of the larger discs are also filled with a numerous collection of hollow spherical vessels, with orifices in their tops, exactly resembling the cupping-glass in their form, and most likely also in their office; namely, that of producing a partial vacuum in each, and whereby the adhesion of the beetle to the substance must be greatly promoted. The middle pair of legs are formed for creeping or walking, much like those of many other insects, and the hinder ones are webbed, and adapted for rowing through the water with considerable velocity.

The larva of this beetle differs entirely in its structure from the beetle produced by it. The beetle has a pair of large compound eyes, whereas the larva has eyes which are formed in several narrow slits on each side of its head, but which, nevertherless, answer the purpose of enabling it to discover its prey with great facility, and which it seizes with two formidable hooked fangs, one on each side of its head, which are perforated, and through them it appears to suck the juices of the animals it preys upon. The Editor has had several of these larva brought to him, with other aquatic insects and animalcula; they usually lurked just beneath the leaves of the *lemna* or duck-weed, with which the surface of the water was covered, and were always on the alert to seize whatever came in their way, and their manner of feeding upon them could be readily seen.

Mr. T. Carpenter has one of these larva of the length of two inches, preserved in spirits. A medical friend of his became possessed of one of these larva in the following most singular way:—A countryman was seized with the most excruciating pains in his stomach, and which continued for so long a period that his case became desperate, and his life was even despaired of. In this predicament, the above medical gentleman, to whom he applied, administered to him a most violent emetic, and the result was the ejection of the larva in question, and which remained alive for a quarter of an hour after its expulsion. Upon questioning the man as to how it was likely that the insect got into his stomach, he stated, that he was exceedingly fond of water-cresses, and often gathered and eat them, and possibly without taking due care in freeing them from any aquatic insects they might hold. He was also in the frequent habit of lying down and drinking the water of any clear rivulet when he was thirsty, and thus in either of these ways the insect in its smaller state might have been swallowed, and remained gradually increasing in size until it was ready for the change into the beetle state, at times possibly preying upon the inner coat of the stomach, and thus producing the severe pains complained of by the sufferer.

During the times the Editor kept these larva they frequently changed their skins, and one of these exuviæ now forms an interesting transparent object for his micoscrope.

On the Lobster Insect.—In the late celebrated Mr. George Adams's excellent work on the microscope, he has given a figure of this insect, in which its two large claws have both of them gaps in them, and which caused it to be considered as a new variety of this well known insect. However, on Mr. Marsham, a late secretary of the Linnean Society, showing the insect to Mr. T. Carpenter, he found, on subjecting it to his test of the microscope, that these gaps were, in fact, accidents, occasioned by the pressure of the two slices of talc between which it was placed in the slider upon the two prominent claws, and which had occasioned the two corresponding fractures which had led Mr. Marsham to consider the insect as a new species, and to have it delineated as such in the above respectable work. However, as Mr. Carpenter had detected the mistake, so Mr. Marsham made him a present of the insect; and upon Mr. Carpenter showing it to the Editor in his micoscrope lately, he found that the fact was exactly as he had stated it: and, indeed, the Editor has another crustaceous microscopic insect, with two similar claws, in his own possession, and in which the same accident has happened to one of the claws from a similar occurrence. This should induce naturalists to be very cautious how they needlessly multiply the varieties of insects, &c.

On taking Impressions of the Compound Eyes of Insects.—Mr. T. Carpenter lately showed the Editor what appeared to him to be the compound cornea of the eye of an insect; it was secured between two slips of glass, as usual with transparent objects for the microscope, and exhibited the minute images of the flame of the lamp and of the forceps with the most perfect accuracy in the numerous concave lenses of which it was composed, and, in fact, exactly as the real compound cornea does. Mr. Carpenter, however, assured the Editor, that it was a creation of his own, and at length informed him, that having accidentally dropped a little gum-water upon the compound cornea of an insect's eye, he found upon removing it, that it had taken an accurate cast from it: this determined him to repeat the application of gum-water more carefully, and to cover the whole cornea and the hairs surrounding it with gum-water, and to remove it when it had become firm enough to bear that operation, but still remained somewhat moist. In this manner he had succeeded in producing the above beautiful cast, and without in the slightest degree injuring the original eye, which was that of a large foreign cerambyx. We think that this process might be applicable also in making casts of other objects. We recollect Baker, in his work on the microscope, giving a somewhat similar process for taking casts from medals in a solution of isinglass made in brandy, and which might also be coated with leaf gold on their insides to give them a metallic appearance. Possibly the mixture of one part of gum-arabic and two of isinglass, dissolved in gin or proof-spirit, and which is used by Mr. Ratley in cementing insects and other objects for the microscope to their sliders, might be still better adapted to the present purpose, as the isinglass corrects the brittleness of the gum, whilst the latter in its turn hardens the isinglass ; and it has likewise the farther advantage of thickening in cooling, so as for the cast to be capable of being taken off sooner than if gum only is used.

On preparing beautiful Configurations of Muriate of Soda (common salt) for viewing in the Microscope.—Amongst the numerous configurations of salts viewed in the microscope, we never find those of common salt mentioned by authors, but only their square, hollow, pyramidal crystals; and, in fact, the Editor never succeeded in producing any, excepting in using an exceedingly dilute solution of salt in water, and wiping it thinly over the surface of a slip of glass, then, indeed, very thin plates of configurations, difficultly discernable by the microscope, were produced. However, in consequence of a fact lately communicated to him by Mr. T. Carpenter, namely, that of configurations being seen formed in the blood, taken from a servant maid of his, who was in a highly inflammatory state at the time, and wiped over the surface of a slip of glass when dry, and viewed in the microscope, it occurred to the Editor that those configurations were evidently caused by a solution of some kind of salt in the serum of the blood, and most likely by the muriate of soda taken in with her food. On pursuing this idea, and adding muriate of ammonia (sal ammoniac) to some blood, and also common salt, he found that both the salts formed most beautiful configurations in it. He then thought of trying another animal substance greatly analagous to serum, mixed with a portion of water, and added common salt to it, until it had a slightly saline taste. This mixture he wiped or spread thinly over the surfaces of several glass slips, and soon had the gratification of viewing an entirely new and beautiful series of configurations forming themselves under his eye, assisted by the powerful aid of his microscope, and which configurations undoubtedly will prove permanent objects. In one of them, however, a second crop of configurations, or more properly crystallizations, formed, superinduced upon the former ones, and still more beautiful than them, they greatly resembling in their circular and gracefully serpentining curves those of the salt of amber, and also much like those of the leaves of pinks or carnations.

On the Parasite Plants upon the leaves of the Damask Rose.—Dr. Hooke, in his *Micrographia*, has given a magnified view of these; and Mr. T. Carpenter having recently given the Editor a leaf with the plants upon it, which merely present to the naked eye a number of irregular dark brown or blackish spots, upon taking off a very small portion of these with a penknife, and laying them between two slips of glass wetted with water, and slightly rubbing them over each other, the mass soon separated, and exposed the form of these curious and minute plants most completely under a high magnifying power in the microscope.

Dr. Hooke's figure of a mass of these plants is very correct; each plant consists of a black cylindrical head or pod, with hemispherical ends to it, which is of about twice the length of its diameter, and in some of the less coloured specimens was seen as being separated across into several divisions. Each plant had also a white pellucid stem to it, with a rough sort of root, whereby it had adhered to the leaf, and likewise a short projecting part at its outer end like a small nipple in its form. The whole affords another beautiful object for the microscope, and when displayed in the above manner may be preserved between two talcs in the sliders for subsequent observation. It ought also to be mounted in substance to be viewed as an opaque object, and as delineated by Dr. Hooke.

On viewing the large and distinct Sap and Air-vessels in the Stems of Angelica, in the Microscope—The leaf stems of this plant are frequently candied by the confectioners in the form of flat slips, of about three-quarters of an inch in breadth and and four inches in length: but whoever has partaken of these cannot but have perceived the hardness of the vegetable fibres composing them. This property induced the Editor to cut the preserved stems across into narrow pieces, of about a quarter of an inch wide, and which he subsequently exposed to the action of warm water, with a view to removing the sugar, and thereby occasioned them again to recover their original form of cylindrical rings. When these rings were dried, by laying them before the fire, he found that they had not suffered in the least degree from the process they had been subjected to by the confectioner, nor from the treatment the Editor had subsequently employed upon them; on the contrary, on dissecting a small longitudinal portion of one of them, by rubbing it between two slips of glass wetted with water, and occasionally removing by means of two sharp-pointed pen-knives, aided by the help of the microscope, the films which enveloped it, he had the pleasure to find the spiral sap-vessels and perforated air-vessels in an admirably perfect state, and of such a large size, as to enable him to view their beautiful structure in a most satisfactory manner; nay, he had even succeeded in unwinding several of the spiral coils of the sap-vessels, not only in single wires, but in twos, threes, and fours; evidently proving that they had existed in the form of single, double, triple, and quadruple screws, winding in the insides of the sap-vessels, and occasioning the ascent of the sap by their capillary action.

These vessels will more readily be found, by cutting out one of the ribbed or linnear prominencies, which stand above the general surfaces of the dried rings, and treating it in the manner before described; as these ribs chiefly consist of a congeries of sap and air-vessels. In fact, it would appear that the dried stems of the plant are much better adapted to the purposes of dissecting and displaying their organization than when in their recent state, and abounding with sap and mucilage. This hint may deserve attention, as the drying process may possibly be equally applicable to many others of the larger tribes of plants previous to dissecting, and submitting them to examination under the microscope.

In the dissection, the Editor held the part to be operated upon fast with the knife held in his left hand, and cut away the films with the other knife; and these instruments may be found quite as convenient, if not more so, than the needle and dissecting knife generally supplied with botanical microscopes. The process, howover, requires great steadiness; the elbows ought to rest upon the table whilst the operator is seated; the hands and fingers will thus be enabled to perform their proper offices; as in the cases of the very delicate works performed by the jeweller, the seal-engraver, &c. where the greatest nicety of operation is required; and, indeed, in using the microscope generally, it is very advantageous to support the body and elbows in a similar manner, in order to obtain that precision of touch which shall enable us to follow the motions of an animalcula in water, for instance, by moving the slip of glass about upon the stage of the microscope.

It appears, that in candying Angelica stems, they are to be first boiled in water till they are tender; so that this process must have nearly extracted the mucilage from them.

The objects thus dissected and displayed between the two glass slips with water between them, when they are become dried by standing a proper time, may afterwards be removed from the glasses, and be preserved between two slices of talc, in sliders, when they will form tolerably interesting objects for the microscope; but by no means so perfect as when viewed with the water surrounding them, and interposed between the slips of glass.

On the magnified representations of the Jaws and Teeth of the Cheese-mite and other Mites.—Great curiosity having been excited, by the mention we made in our last number, of Mr. T. Carpenter having succeeded in entirely separating and exposing the two sets of teeth and jaws of the cheese-mite, as objects for the microscope, we have gladly availed ourselves of Mr. Carpenter's kind permission to have drawings made of them, and to have them engraved in the plate accompanying the present number.

In plate III. fig. 7 represents these curious microscopic objects, viewed through a lens of the twentieth of an inch focus. It will be seen, that two of the jaws are larger than the other two. There is also an appendage jointed to each pair of jaws, somewhat resembling a finger in shape, one of which is dislocated from its union with the jaws, and is represented closely adjoining to it. In others of the mites which Mr. Carpenter has endeavoured to separate, he has found two other appendages to their mouths, resembling the small claws of a crab or lobster: these are still more perfectly exhibited in a mite taken from a swallow's nest, which most likely came off one of the flies upon which the bird fed, he having found similar mites upon the blue-bottle fly. These mites have each an appendage to their head, similar to that shown in fig. 8, and which seems to be composed of two pair of curved jaws, similar to those of the cheese-mite, crossed upon each other; and would therefore indicate, that the action of the two sets of teeth was similar to that of scissors or shears, cutting sideways, somewhat like the action of a cow chewing the cud, and not up and down as in the usual manner of chewing.

On Mr. T. Carpenter's *made of preserving Minute Objects.*—The Editor now finds, that the mites are secured between two slips of thin Dutch plate-glass, of about two and a half inches long, and five-eighths of an inch broad; the uppermost of them, or that next the eye of the observer, being the thinnest of the two slips. Thus these glass slips must be less than the twentieth of an inch in thickness, the objects placed between them being capable of being viewed with a lens of that focus. The thickness of the other, or undermost, slip is immaterial; and, indeed, it might be formed of common crown glass. The plate-glass affords a most clear and distinct view of the objects, infinitely superior to that presented by the use of mica or talc, as usual. Mr. Carpenter applied a little thick gum-water to each end of the slips before joining them together, and then pressed them very hard, to close them as much as possible. He then surrounded the ends with bands of writing paper, cemented likewise with gum, on which he has written the number of the slider, corresponding with a list of the contents of the different sliders contained in that drawer of his cabinet, so as to be instantly referred to when needful.

(*To be continued.*)

XX.—*On the French method of Gilding upon Bronze.*

By M. D'Arcet*.

This species of gilding, by the English called *water gilding*, is performed upon several different metals and alloys, as upon silver, copper, brass, and pinchbeck; which latter is an alloy of copper and brass, or of copper with a smaller portion of zinc than enters into the composition of brass. This alloy, as well as that of copper and tin, the French denominate bronze, whilst we, in general, restrict the latter term to compounds of copper and tin only. In gilding upon metals, the colour, beauty, and quantity of gold required depend much upon the nature of the alloy upon which it is laid; that which consists principally of copper and zinc is to be understood in the following article, where bronze is named.

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* From the *Franklin Journal*, and translated from the *Dictionnaire Technologique.*

Gilding upon Bronze.—The art of gilding upon bronze has been perfectly described by M. D'Arcet in a memoir on the art of gilding on bronze, which, in the year 1818, obtained the prize from the Academy of Sciences. From this memoir we will now extract as much as shall appear necessary to describe the art, and to make known the improvements which M. D'Arcet has introduced in the mode of conducting it. Those who wish for further details we must refer to the original memoir.

The art of the gilder consists in the application of gold over a surface of bronze, by the assistance of mercury, with which the gold is amalgamated; the mercury is evaporated, and the gold fixed, by the application of heat; it is then *burnished*, or left *mat*, in whole or in part, according to the nature of the work.

The gold should be pure, or very nearly so; it should be made very thin, either by the hammer or the flatting mill, to expose a large surface and favour its dissolution by the mercury. The mercury employed should also be perfectly pure, as the impurities which it contains will otherwise be deposited with the gold, on the surface of the bronze, and consequently deteriorate the work.

Preparation of the Amalgam of Gold.—The workman, after weighing the fine gold which is to be amalgamated, puts it into a small crucible, which is placed in a charcoal fire on the bed of the forge; the crucible is heated to a light red, and the requisite quantity of mercury thrown in; the mixture is stirred with a small iron rod, bent for the purpose, suffering the crucible to remain for a few minutes upon the fire, until it is known that the combination is effected: the amalgam is then thrown into a small pan containing water, and carefully washed, by squeezing it with the thumbs against the edges of the vessel, allowing all the running mercury to escape which can be in this way separated. The amalgam which adheres together, so as to be capable of sustaining the impression of the finger, must be protected from dust, as it is that which is to be used in gilding, in the manner to be described.

The larger the proportion of mercury in the amalgam the thinner will be the coat of gold deposited on the article to which it is applied, and *vice versa.* It is easy to conceive that amalgams may be formed of various proportions; the ordinary composition, howevet is formed of eight parts of mercury to one part of gold. The mercury in this case is in excess, for after straining it through chamois skin, so much is separated as to leave in a hundred parts, mercury, 33; gold, 67; total, 100.

The running mercury which is separated by the pressure of the fingers contains a considerable portion of gold in solution; it is an amalgam with a large excess of quicksilver, and is used either in making fresh amalgam or in giving a coat to such articles of brass as are intended to be very lightly gilt.

Among other precautions, to avoid injury to the workman, he should be careful to compress the amalgam with chamois skin, and wear leather gloves during the operation.

Preparation of the Nitric Solution of Mercury.—The prepared amalgam is applied to the work by the aid of nitric acid, holding a small portion of mercury in solution. The following is one of the methods recommended by M. D'Arcet:—into a glass matrass put 3¼ troy ounces of mercury, and 4½ of pure nitric acid, of 36° (sp. g. 1. 333;) the matrass is to be placed under a chimney with a strong draft, and suffered to remain until the solution is complete.

This is to be poured into a bottle, and 11 and a-half pints of distilled, or rain water, added to it, agitating it well, and preserving it for use.

Gilding.—After these several preparations have been obtained, the gilding is effected in the following manner:—

1st. When the work has been completed by the turner, or the chaser, it is to be *annealed,* for which purpose it is placed upon lighted charcoal, and surrounded with the same, or, in preference, with cakes of tan, which affords a more equal and less intense heat; it is to be completely covered in order to prevent oxidation. It is to be carefully watched, to prevent the thinner parts from being more highly heated than those which are thick; this operation is best performed in a dark place. When the piece has arrived at a cherry red the workman removes the coals, and, with a pair of long-handled tongs, places it where it will cool slowly.

2. *Pickling and Dipping.*—The design of this operation is to remove from the bronze the coating of oxide with which it has become covered in *annealing.*

The piece is put into a wooden or earthen vessel, containing sulphuric acid, very much diluted with water; it is there left until the oxide is entirely dissolved, or at least softened, when it is to be rubbed with a rough brush; when the piece has been well pickled and washed it is to be dried. The surface will be still discoloured, and it is to be dipped into nitric acid of 36° of Baumé (sp. g. 1.33,) and rubbed with a long-haired brush; this exposes the metallic surface, but does not render it sufficiently clean: in order to obtain a fine metallic lustre, it is dipped into nitric acid of the same strength, into which is thrown a little soot and common salt. This last circumstance induced M. D'Arcet to apprehend, that the cleansing might be effected perfectly by using sulphuric and muriatic acids instead of nitric acid, which last attacks the pure copper with much greater ease and force than these two acids. In every instance, he observes, the dipping, when well performed, ought to dissolve nothing more than the oxide formed on the surface of the piece during its annealing, and not attack the metal itself in any degree, which is difficult to prevent when the dipping is performed with nitric acid.

The dipping having cleaned the surface, the piece is to be carefully washed in a large portion of water, and rubbed in bran or in the sawdust of some wood which is free from resin; this will dry it perfectly, and prevent the tarnishing of the surface from humidity. The piece ought now to appear bright and perfectly free from oxide; the metallic surface should be everywhere perfectly seen, and should exhibit a fine pale yellow colour; it should also appear grained or lightly matted. If too smooth, the gold will not readily adhere, and if too deeply matted, the gilding will require a quantity of gold which will render it too expensive.

3d. *Application of the Amalgam.*—The piece being prepared as directed, is ready for the application of the amalgam, which should be put into a flat earthen dish which is unglazed, and of a rough surface; a gilder's scratch brush, or a pencil made of fine brass wire, is to be dipped into the solution of mercury in nitric acid, of which we have already spoken.

The scratch brush is then pressed upon the amalgam, which, by giving the earthen dish a slight inclination, is left on its side; by drawing the scratch brush towards himself the workman charges it with the desired quantity of amalgam, which is then applied to the article intended to be gilt; this is to be spread carefully over the work, dipping the scratch brush again into the acid solution, and into the amalgam, should this be necessary. A skilful workman will deposit a larger portion of the amalgam on those parts where it may be desirable to gild with greater strength.

The piece is then to be washed in a large quantity of perfectly clean water, and which has not been used for previous washings; it is then dried and carried to the fire to volatilize the mercury. Should the first coating of gold not be sufficient, the piece is again washed, and the operation repeated in the way already described.

4th. *Volatilization of the Mercury.*—When the work is properly covered with the amalgam, the gilder places it upon lighted charcoal, turning it about, and heating it slowly to the requisite degree, withdrawing it from the fire with a pair of long-handled tongs, held in the left hand, which is guarded from the fire by a thick, wadded, leather glove; with a long-haired brush he dabs and rubs the whole surface, so as to spread the amalgam equally, turning it in all directions for this purpose.

The piece is then replaced upon the fire and heated with the same precautions as before, until the mercury is completely volatilized, which is ascertained by the noise made by a drop of water, which the workman throws upon it, and also by the time which the drop requires to evaporate. During the operation he repairs those spots which may be defective, being careful to volatilize the mercury very slowly. When the work is perfectly covered with gold, it is carefully washed and scratch brushed in water acidulated with vinegar.

If the work is to be partly burnished, and partly mat, the part which is to be burnished is to be covered with whiting, powdered sugar, and gum, tempered in water. This operation the workman denominates *guarding*. When the workman has *guarded* these parts, he dries the piece and again heats it sufficiently to drive off any mercury which may yet remain; this he perceives by the colour which the work assumes, and by the blackening of the coat of *guarding*. After this he plunges it, whilst yet warm, into water acidulated with sulphuric acid, washes it, wipes it dry, and burnishes it.

5th. *Burnishing.*—This is effected by rubbing the piece with burnishers made of *hæmatite* or blood-stone. The burnishers are dipped in vinegar and water, and the work, in burnishing, always rubbed in the same direction, passing the instrument backward and forward, until the required lustre is obtained. When the burnishing is completed, the piece is washed in cold water, wiped with fine linen, and gently dried upon the bars of a chafing-dish containing lighted small coal.

6th. ***Matting.***—The parts to be burnished, if such there be, having been covered with the guarding, the piece is attached by fine iron wire to the extremity of an iron rod; it is then highly heated, until the guarding becomes brown in consequence of the roasting of the sugar and the scorching of the gum which enters into its composition. The gilding will thus acquire a fine gold colour; it is then to be covered with a mixture of common salt, nitre, and alum, liquefied in the water of crystallization which these salts contain; the work is again carried to the fire and heated, until the saline coating becomes of a homogeneous texture, nearly transparent, and is in a state of real fusion; the piece is then withdrawn from the fire, and suddenly plunged into cold water, which will remove the saline coating, and also the guarding. The work is afterwards dipped in very weak nitric acid, washed in abundance of water, and dried, either by exposing it to the air, warming it upon the chafing-dish, or gently wiping it with clean dry linen.

(*To be continued.*)

XXI.—*On a Machine for opening Horn, for the use of Lanthorn-Makers, Comb-Makers, Cutlers, &c. By Mr.* J. James*.

Horn is prepared for the use of lanthorn-makers, comb-makers, the cutler, &c. by making it into flat laminæ of various thicknesses, according to the use for which it is intended. The horns are first cut transversely into pieces, according to the use to which each is applicable. The pieces are then slit longitudinally, and are held separately over a naked fire, till heated to the degree at which horn becomes soft; they are then hammered flat by a mallet, and placed in a strong press till they become cold.

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* From Vol. XLV. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce. The society voted the silver Vulcan medal and five guineas to Mr. James.

Mr. James, who is himself a worker in horn, objects to softening it over a naked fire, in consequence of its frequently being scorched or frizzled, more especially as in opening the old hard horns it is necessary to allow the flame to enter the hollow, that the inside may be rendered equally soft as the outside.

The apparatus employed by Mr. James is a block of cast iron, with a conical hole quite through it, and a plug of the same metal, about one-eighth of an inch less in diameter than the hole. The block and plug are both to be heated in a common fire, or in a stove, to about the temperature of melting lead; the block is then taken out and placed on a firm support, a piece of horn previously slit is put into the hole, and the heated plug is dropped within the horn. This latter being heated, both from within and from without, soon becomes soft; The plug is then carefully and gradually driven in by a mallet, and by its pressure soon redresses any original crookedness of the horn. After being left for about a minute in this state, the plug is to be driven out by turning the block on one side, and the horn being then withdrawn will be found quite soft enough to be opened and pressed in the usual manner. Considerable saving of time is thus obtained, and all risks of overheating the horn is avoided.

XXII.—*On Lithography. By Count* M. D. LASTEYRIE, *of Paris.*

(*Continued from Page* 120.)

On the Paper, and the mode of Wetting it.—The kind of paper to be used in lithography is not a matter of indifference, particularly when impressions are to be taken from a highly-finished crayon drawing. The paper is the better for being thick and soft, especially if it swells, so as to prove elastic in the process of printing. The impressions come out best on unsized paper; that, however, which is thin and sized, may be used for drawings in ink or for writings. A waste sheet of paper is always placed on that which is to receive the impression, and when it is thin even two are used, in order to produce an impression more perfect and regular. Sized paper requires to be wetted more, and to remain in that state longer than that which is not sized, but it affords in general fewer impressions. That which is impregnated with lime, alum, or substances of a similar nature, spoils the beauty of the impressions, and prevents the taking many of them. They are likewise injured by folds and bulbs in the paper, but more particularly by particles of sand; these last form lines on the drawing, cut the leathers of the presses, and make hollows in the scrapers, rendering them unfit for use. The paper ought to be of a uniform and regular texture and thickness. In order to wet the paper, one or two sheets are taken at a time by the two corners of one end, and drawn through a shallow tub full of clear water; they are then laid carefully on five or seven dry sheets, and covered with an equal number; continuing thus alternately to place together wet and dry paper, taking more or less of one or of the other, according to the nature of the paper. The whole is placed between boards, on which weights are laid, in order that the moisture may be equally diffused throughout it; more weights are added at the end of an hour, or what is still better, the paper is put into a press. If it be desired to take an impression without delay, and there is no moistened paper prepared, some may be soon procured by damping one side of each sheet with a sponge slightly moistened, and pressing the whole for a few moments. When the drawings are made with ink, the impressions may, on an emergency, be taken on dry paper, but in this case it may be sized. The moistened paper of which we have just spoken should remain under pressure for ten or twelve hours—it may be continued in this situation for twenty-four hours, but if it remain longer it will dry and become mouldy. Whenever it is found that the impressions cannot be taken until the expiration of this time, the paper must be removed from the pressure, dried in the air, and wetted again when it is wanted for use. When the paper is too wet it does not take the ink well, and yields inferior impressions, and, moreover, has the disadvantage of sticking to the stones. Experience will soon teach the degree of moisture which ought to be given to the different kinds of paper which may be employed.

Manner of Outlining the Drawings upon Stone.—Tracing facilitates and abridges the work; and it is indispensable when it is desired to produce a fac-simile, or to obtain with the least possible trouble a copy of a drawing, the impressions of which are wanted to stand in the same direction of the original. In this case a transparent paper is taken, such as is known in commerce as *papier vegetal*; or any other kind that is free from those fatty resinous substances which may dirty the stone by taking the printing ink. This paper is laid on the model, and the outline and other principal lines of the design are traced with a lead pencil, or what is still better, with red chalk, which leaves more visible traces on the stone. The outline thus obtained is placed on the stone, which has been previously rubbed with a little spirits of turpentine, or slightly moistened with water; it is then covered with a sheet of paper, and subjected two or three times to the action of the press. The lines made on the paper will by this means be produced on the stone, and serve to guide the artist in his design. It is not necessary to endeavour to efface any of the marks of the crayon which may appear after the drawing is finished, as they will not injure the impressions in the least. When it is of no consequence obtaining the impressions in the same direction with the original drawings, and there is no press at hand, the outline may be obtained on the stone by rubbing it on the reverse side with chalk, or with plumbago pounded and sifted. It is then fixed on the stone with wafers, and the lines which are to be transferred to it are passed over again with a blunt point. If it is wished to avoid colouring the reverse side of the outline, a sheet of tissue paper is interposed between it and the stone, which paper has been coloured with red chalk on the side which is to be placed next the stone. By so doing and then tracing the outline with a point, it is made to appear on the stone. This mode may be employed for fac-similes, and for all kinds of drawing, it being only necessary to retrace the lines already made either with ink or crayon, as is done with a point or a graver, in working upon copper.

On the Precautions to be observed in Writing or Drawing upon Stone.—When it is desired to write or draw with ink immediately on the stone, either when the sketch has been obtained by transfer, or traced by hand with a crayon, we proceed exactly as we are accustomed to do when we work on paper, whether we use the pen or the pencil. We would remark, however, that practice and a certain lightness of hand are necessary, in order to make, with facility, neat and delicate lines on stone. Highly finished works should not be undertaken without previous practice. The ink takes better and spreads less when the stone has been well polished, and rubbed with spirits of turpentine, or with water, a little soapy; the former, however, is preferable. When the stone is rather soft, there should be mixed with the spirits of turpentine a little of lithographic ink, and with this the stone is to be slightly rubbed with a linen cloth until it acquires a grayish tinge. The artist should be provided with steel pens, pens for drawing lines, and sable pencils, of different sizes, according to the kind of work to be done; each person choosing that instrument with the use of which he is most familiar. It is necessary in both cases to have the lithographic ink so thick as that the lines made on the stone may be of a deep black, and still thin enough to flow with sufficient freedom from the pen. It should be about the consistence of thin cream. If it is too liquid it may be thickened by rubbing in it a stick of ink; if, on the contrary, it is too thick, a few drops of water may be added to it, mixing them by shaking them together in a bottle. It is necessary to the beauty of the impression, that all the lines of the design should be drawn with the same intensity of colour. The ink often forms into a little mass on the end of the pen in consequence of its thickness, or of certain particles which have rubbed up from the stone; it is necessary then in this case to wipe the pen with a rag, or it may be sufficient simply to rub the sides of its point against the vessel which contains the ink. It is well also always to try it on the edge of the stone, in order to avoid the danger of making thick slovenly lines in the design.

Beginners find a difficulty in making the ink flow when attempting to draw on stone, with a steel pen or a ruler; but this difficulty is soon overcome by practice and patience if the instruments used are good. The use of the pencil is more easy though less expeditious than that of the pen. All that is necessary is to keep it supplied with a small quantity of ink, and to work with a light hand, taking care not to repeat the strokes. When the ink has thickened in the pencil it should be wiped and fresh ink taken.

It is easy to perceive that when it is desired to write on stone the characters must be reversed, and the work done from right to left, in order to have the impressions in the directions of ordinary writing. This is an art which cannot be attained without a certain apprenticeship, while writing on paper with lithographic ink may be done by all who know how to write.

Drawings in crayon do not require less care than those in ink. They ought to be executed with a free, bold, and strong touch. If the crayon be passed lightly over the stone, it will produce pale lines, which will often be lost in the printing; and it is in vain to endeavour to give strength and effect to these by going over them a number of times: the succeeding touches, as well as the first, being made faintly, and with indecision, will fail to adhere to the stone, and will disappear, or become coarse and confused.

It is necessary to be very careful to work on stones that are perfectly clean, whatever may be the kind of design which it is desired to execute. Negligent workmen often neglect to wash the stones carefully, so that they may be sometimes found covered with a slight coat produced by the material used in the polishing. It is necessary, also, to wash them well with a clean linen cloth before using them, in order to remove the dust with which they may be covered. They may likewise be rubbed with a cloth, moistened with spirits of turpentine. A paper should be placed under the hand, so that it may never rest on the stone, and great care should be taken that the design be not rubbed; in order to avoid the danger of this, the hand should rest on a wide ruler, supported by two little strips of wood, as has been before explained.

It is more convenient, when drawing with crayons, to cut a number of them before beginning to work, so as always to have some ready at hand for which to change that in use when it has become blunt, or has softened by warmth, without being perpetually interrupted in the work. Besides, if the crayons are cut over the stone it may be soiled by the little fragments which would adhere to the design, be broken up in the printing, and produce dark spots. Little pieces often become detached from the crayons, in the act of drawing, and may be discovered by examining the stone against the light in an angle of 45 degrees. In this case it is necessary to remove them with the point of a knife. When these little pieces are perceived on the point of the crayon, they may be removed by turning the port-crayon round and round between the fingers, and rubbing the point of the crayon on the edge of the stone, or on some other substance.

When drawing on stone, it is necessary to be very correct; for every line once made will be reproduced, unless it be erased, which it is difficult to accomplish. There is no other means of doing it than by using the point of the scraper. If the drawing is in ink, the part which it is desired to correct must be obliterated with the scraper; and in order to prevent the ink leaving any trace, it is sufficient that the stone should be cut very superficially, and without producing a hollow in it, or taking off its polish; but leaving it so that the new lines may be made on the same place. Those lines which are too thick, or ragged, are corrected by means of the same instrument.

The difficulty is greater in correcting a drawing of crayons, done on a grained stone; for if the grain has been removed wish the scraper, it will not be found possible to use the crayon on those parts which have been thus polished. In this case it is absolutely necessary to make use of the point of the scraper, or of some other sharp instrument; with this, those tints which are too deep and strong may be softened, and the harmony of the different parts of the drawing restored. Those parts which have been blackened by the crayon may be removed by picking with a point, without injuring the grain of the stone. When it is wished completely to remove any part of the drawing, the point of a scraper will not answer the purpose; in this case it is necessary to erase it by placing some sand on it, and rubbing it about with a mullar. The crayon is thus removed without destroying the grain of the stone; and after having cleaned this part with a brush, and rubbed it with a piece of linen, the drawing may be again made on it. The same method is employed, when, by accident, a spot of ink, of grease, or of saliva, has fallen on the stone.

Autographic Processes.—We have said that the autographic process consists in transferring a writing to stone.

To effect this, the drawing or writing is made with ink, on paper, both prepared in the way we have described. A crayon drawing may, on an emergency, be executed autographically; but this mode of procedure is too imperfect to admit of procuring, by its means, clean and perfect proofs. Besides, it is as expeditious to draw immediately on the stone.

In order to write or to draw on autograph paper, a little of the ink, of which we have given the composition, is diluted in water, taking care to use only rain water, or such as will readily dissolve soap. The dissolution is facilitated by slightly warming the water in the cup; and the ink is dissolved by rubbing the end of a stick of it, in the manner practised with Indian ink. There should be no more dissolved at a time than will be used in a day; for it does not re-dissolve so well, neither is the ink so good, particularly for delicate designs, after it has been left to dry for several days. This ink should have the consistence of rather thick cream, so that it may form very black lines on the paper; if these lines are brown, good impressions will not be obtained. A sheet of white paper is placed under the hand, while writing, in order that it may not grease the autograph paper.

The stone used for autography should be polished with pumice stone; and the impressions will be neat, in proportion as the stone is well polished. Autographic work may be executed either cold or warm; that is, either taking the stone at its ordinary temperature, or making it warm by placing it near the fire, or exposing it to the heat of the sun; if the first means of warming it be used, care must be taken that the fire is not too hot, or it will crack the stone: the temperature given to it should be about that of an earthen vessel filled with lukewarm water. The work may be done, though less perfectly, without warming the stone.

When the stone is thus prepared, it is fixed on the press, and the paper on which the writing is made is applied to it. The stone may be rubbed with a linen cloth, slightly moistened with spirits of turpentine; and in every case it is necessary that it be made perfectly clean. The turpentine is left to evaporate; and from five to eight minutes before the paper is applied, it is wetted with a sponge and water, on the reverse side to that on which the writing is done, so that the moisture may penetrate throughout every part. The water, however, must not appear on the paper when it is about to be laid on the stone; but any superabundance which may remain on it must be removed by a pressed sponge. When the paper is brought to the proper state, it is taken, by both hands, at one of its extremities, and placed lightly and gradually on the stone, so that there may be no plaits formed in it, and that it may be equally applied over its whole surface. Care must be taken so to fix the scraper, that it may bear steadily on the autographic paper, for if it removes it at all, it will change the place of pressure, and the lines will be doubled. There should be ready at hand five or six sheets of very even mackle paper, so that they may be changed with each impression. The paper on which the writing or drawing is made being placed on the stone, it is covered with a sheet of mackle paper, and subjected to a slight action of the press, then to a second, a third, or even to more, until it is believed that the writing is perfectly transferred. At each stroke of the press the mackle paper, which has imbibed moisture, is withdrawn, and a dry sheet substituted in its place. All these operations require to be performed with expedition and dexterity, particularly when the stone is warm. The next thing is to detach the autographic paper, which will be found adhering closely to the stone. To effect this it is well wetted with a sponge, so that every part of it may be perfectly penetrated by the water; it may then be removed with facility, entirely detached from the writing, which will remain adhering strongly to the stone. If this operation, which requires some practice, be well performed, there will not be found the slightest trace of ink remaining on the paper. Should there be any lines not well marked on the stone, they may be retouched with a pen, or, which is better, with a hair pencil and ink; but when this is done, care must be taken that the stone is quite dry.

A part of the sizing of the paper may be found dissolved and adhering to the stone; this may be removed by washing, or slightly rubbing it with a wet sponge. The stone is then prepared with aqua fortis, and the impression taken in the way we shall describe in another number of this work.

Autography is not confined to the transferring of writings or of drawings done with autographic ink. By its means a transfer may be obtained from a sheet of ordinary printed paper, and with such exactness, that it would be impossible, excepting to well practised eyes, to perceive the least difference between that printed in the usual way, and that which was the result of the autographic process. This mode is very useful when it is desired to unite oriental characters which we may not possess, with words, phrases, or lines, composed in our ordinary typography. We have thus executed many pieces in which the French, or the Latin language, was intermixed with words or phrases, in Chinese or Arabic. We have, in the same way, executed a typographic map, in which all the details were lithographic, while the names of places were at first produced by typography, and afterwards by autography. This operation is begun by composing and arranging, in a typographic form, the words, the phrases, or the lines, as they ought to stand. The autographic paper is printed on by this form, and the words in the oriental languages are afterwards written in the spaces which had been left for them. The whole is transferred to a stone, which is prepared for the purpose, and from which the impression is taken in the usual manner. The same mode is pursued in making geographical maps. After having printed the names on autographic paper, the other parts of the map, but without the names, are drawn immediately on the stone; and after having printed the names on white paper, the map, drawn upon the stone, is printed on this same paper.

Maps, or line engravings on copper, where the work is not very close, may be multiplied in a similar way. For this purpose, the plate of copper is covered over with the autographic ink, diluted to a convenient consistence. Instead of the autographic ink, a composition is sometimes used, made of one ounce of wax, one of suet, and three ounces of the ink with which the ordinary impressions in lithography are taken. The whole is warmed and mixed well together, and there is a little olive oil added to the composition, if it is not liquid enough to spread itself over the plate. The plate ought to be warmed as usual. After having taken the impression in the rolling press on a sheet of autographic paper, the transfer may be immediately made on the stone, after having rubbed it with a sponge dipped in turpentine. It is necessary to give three, four, or even more strokes of the press, increasing the pressure at every successive stroke; the other processes, which we have already described, are likewise to be followed. It is well to wait twenty-four hours before preparing the stone, in order that it may be better penetrated by the transferring ink; it is then gummed and washed, and is ready for use.

This process, which has not come into use amongst lithographers, merits the attention of artists: for it affords the means of reproducing and multiplying geographical charts, and some kinds of engravings, indefinitely; so that they might be furnished at a quarter of the present actual value. In fact, all those which are done in lines, or those in which the shadows are boldly executed, are capable of reproducing good impressions by means of autography. The operation becomes extremely difficult when it is necessary to transfer fine line engravings; the lines of these are so delicate, and so near to each other, that they either do not take well on the stone, or are apt to be crushed and confounded together, by the effect of the pressure. Much practice and address are necessary to obtain tolerable impressions; and this part of the art requires improvement. We have, however, succeeded in transferring to stone, a small, highly-finished engraving, which had been printed on common half-sized paper. After having dry polished a stone very perfectly, we warmed it, rubbed it with spirits of turpentine, and applied the engraving to it. This, however, had been previously dipped into water, then covered on the reverse side with turpentine, passed again through the water, so as to remove the superfluous turpentine, and then wiped with unsized paper. In this state the engraving, still damp with the turpentine, was applied to the stone, and submitted to pressure, when it afforded us very good impressions; the preparation not being applied until it had remained on the stone for twenty-four hours. The difficulties increase, of course, in proportion to the size of the engravings which it is desired to transfer to the stone.

Attempts have been made to transfer old engravings; they have, however, succeeded but imperfectly; it would be rendering an essential service to the art, to discover a mode of reproducing old engravings by means of autography; the thing presents great difficulties; still, from the attempts of the kind which we ourselves have made, we think it possible to succeed. It shall suffice at present to give some account of the mode we pursued. The ink of old engravings being brought to a state of complete dryness, it is necessary to give it a body and unctuosity. To effect this, the engraving may be well soaked in water, in which some soda, sal ammoniac, or salt of sorrel, has been dissolved. The engraving is then stretched out on a plank, and spirits of turpentine spread over it, pressing it in with the finger or the palm of the hand, so that the lines of the engraving may be perfectly impregnated with the turpentine; it is then laid on a warm stone, submitted to pressure, and removed from the stone by wetting it with water. If the engraving has been made too wet, it should be gently pressed between some sheets of unsized paper, before placing it on the stone. It should be inked afterwards with the roller, or, which is better, with the *retouching ink*, of which we have given the composition. For this purpose a printer's ball is used; these are made of wool, and covered with thin untanned leather.

The autographic process presents great advantages in a variety of circumstances, and in different kinds of work; particularly when economy and expedition are necessary. It is especially adapted to the circulation of all such writings as require an immediate publication; such as advices relate to commerce or to private or public interests: to memoirs, or to scientific or literary communications, &c. which are only intended for a small number of persons; any one might have a press and use it by himself, or with the assistance of his agents or his servants. In this manner, and in a way the most economical, geographical charts, geometrical figures, and every kind of design made with the pen, might be produced. Authors who have any knowledge of drawing, might themselves execute their works on autographic paper, without having recourse to artists; for it requires a certain apprenticeship to be able to write or to draw backwards with ink on a stone.

(*To be continued.*)

XXIII.—*On making extensive Plantations of Forest Trees, on Soils of Chalky and Gravelly Quality. By* WALTER LONG, *Esq.*[*]

SIR, *Preslaw House, near Bishop's Waltham, Hants, Jan.* 22, 1827.

ENCOURAGED by the liberal interest which the Society of Arts feels towards gentlemen who have devoted their time and attention to plantations, with a view to raise profitable timber, I have ventured to lay before you some ac-

[*] From vol. XLV. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce. The society voted its gold Cerés medal to Mr. Long, for his meritorious exertions.

count of my proceedings for the last few years. While engaged, I had in view not merely the beauty which, I flatter myself, I shall have added to the surrounding country, but also the expectation of raising a property of considerable value on land, in its previous state not worth more than from five to seven shillings per acre, and the hope that I might be so fortunate as to obtain the gold medal, to hand down to those who succeed me, as a lasting testimony of my labours. But a variety of difficulties of soil and climate, and repeated disappointments from year to year, have occurred to prevent my intruding myself upon the society in the character of a candidate: by continued perseverance, however, those difficulties have all been surmounted; nearly two hundred acres of very dry, poor land are now covered with plantations in a very thriving state; and I am not without a sanguine hope that, when the society have taken all the circumstances hereafter detailed into consideration, and that, one year after the other, I have still procured more and more trees, and in some cases have replanted the same ground three and four times over, they may be disposed to bestow upon me some honorary mark of their approbation.

Previous to the year 1820, I had made some plantations in extent not more than six acres; but, owing to the dryness and shallowness of the soil on a bed of chalk, for four or five years they made so little progress, and looked so very sickly, that at that time I felt little encouragement to persevere. At the end, however, of four or five years, these sickly plantations assumed a very healthy appearance, and the larch and Scotch firs put forth such fine shoots, as to excite the admiration and surprise of many of my neighbours; and so greatly was I struck by it, that all my ardour for planting revived, and I then determined to plant the surrounding high grounds, which are seen from a great distance. In the year 1820, I happened to visit the very extensive plantations of the Duke of Athol, at Dunkeld, and from Messrs.

Donaldson, nurserymen at Little Dunkeld, I obtained information as to the mode followed there. I ordered from them a quantity of seedling larch, and hired a man from Scotland, who had been accustomed to the business. In February, 1821, I followed strictly the directions I had received, which were, merely to open the ground in three cuts, with a small triangular, sharp-pointed spade; then, with the instrument, move the ground a little under the sward, and insert the seedling plant. This was done by the Scotsman, Alexander Forbes, over five acres. They were planted with the 12,000 seedling larch, and 13,000 spruce and Scotch fir-seedlings, at 5,000 to the acre, which I received from Messrs. Donaldson. In January and February, 1822, the same plan was followed over about thirty-four acres, and they were planted by Alexander Forbes, and some labourers under him, with 150,000 seedling larch from Messrs. Donaldson. These attempts excited my greatest interest. The trees had been planted in a very shallow soil, and in an exposed climate, upon a plan different from the usual expensive mode of this country, more simple, and at much less cost. I watched the result with anxiety, but it did not succeed. The situation is so high, that from it the whole of the Isle of Wight, and the water between it and the main land, is visible at a distance of twenty miles; the soil is hardly three inches in depth from the chalk; but these causes alone would not have defeated me, had there not been a total want of moisture. In Scotland, where the above mode of planting is followed on the high mountains, there are rills of water trickling down, penetrating to the roots of the young seedlings; so that, without being previously bedded in a nursery, the seedlings soon make root, from having moisture to feed upon. Besides this, from the trees not arriving in time from Scotland, it was not possible to plant them till February, which, in this dry soil, is too late: the March winds check them at once. After this disappointment, I had to begin my operations anew, and upon a different system; and whilst I had all the old ground to go over again, I determined (that I might lose no time by my failure) to proceed, the ensuing season, with the new plantations, to the same extent as if I had not failed in the former instance. To guard against further disappointment, I entered into a contract with Mr. Joseph Thompson, a nurseryman near Southampton; he agreed to plant the most proper description of transplanted trees, at twenty-five shillings a thousand, finding the trees, and paying all the labour, and to replace every failure for the space of three years. On sixty-one acres of land he planted, in October and November, 1822, 37,000 oak, 36,000 Scotch firs, 58,800 larch, 53,600 beech, 1,000 birch, 3,000 Spanish chesnut, 10,500 spruce firs, 25,000 ash, 1,000 English elm, and 2,000 sycamore, at twenty-five shillings a thousand; in the whole, 227,900 sent; — 27,200 used by Alexander, — 200,700, the quantity used by him in his contract, as is proved by Mr. Thompson's bills, are deducted from his amount, *at twenty-five shillings* the thousand, 40,000 larch and beech beyond this calculation, which were returned. The oak, ash, Spanish chesnut, elm, and sycamore, were planted, mixed with larch and firs, in those lands called Pinlands and Belmores, to the westward, where the soil was deeper, and the grounds more sheltered; and two pieces were planted at first entirely with oak; the higher lands were filled with beech, larch, Scotch and spruce fir, and birch, and, upon the average, contained about 3,500 trees to the acre. The lands called Pinlands and Belmores, to the westward, near the Winchester road, were small inclosures, surrounded by high woods of beech, oak, &c.; and they were selected for planting, because they were wholly unproductive for corn or grass; the fog or mildew from the woods, and continual shade, rendered the ground sour, and the corn scarcely ever ripened, or even filled the surface of the earth; the grass that grew there was so coarse and sour, that it produced in sheep the disease called the redwater. It therefore can fairly be called land unprofitable for tillage. We pursued what I consider an excellent and economical plan for preparing the land. We ploughed the ground in drills four feet distant from each other, throwing out two furrows from each drill, and getting completely under the soil; the labourers then worked under the surface on each side of the drill with their pick-axes; and when the ground was thus sufficiently moved, the hole was opened, and the trees planted. The ground that has thus been moved, afterwards settles down rather lower than the rest that has not been moved, and this forms a most profitable receptacle for the rain that falls on the surrounding surface, by which means the trees receive more moisture to their roots. The whole of this work was performed with spirit: by having at least sixty hands, we planted five acres a day, and the whole was completed before the frost set in. As soon as these sixty-one acres were finished, I set to work to replant and fill up the ground where the trees had previously failed. Six acres of the field in Rowberries, No. 2, planted in 1821, I had ploughed in drills, in the manner described, and filled with larch, Scotch firs, and beech, three and four feet apart, transplanted trees, and all the rest of the thirty-four acres, previously planted with larch seedlings from Scotland, a detachment of men, under Alexander Forbes, carefully filled up by holing, and in this work used all the Scotch seedlings, pinaster ditto, beech, sycamore, and birch, to the amount of 90,500, charged at a reduced price in Mr. Thompson's bill, and also 27,200 of the transplanted ones, which, in Thompson's bill, were charged at twenty-five shillings, intended for the contract work, but which were used by Alexander Forbes, in the land ploughed in drills in Rowberries, No. 2. Alexander Forbes, in replanting the hills, by holing, used 40,000 Scotch seedlings, 10,000 pinaster seedlings, 800 birch, 6,200 beech, 1,300 Spanish chesnuts, 2,200 sycamore; in all, 60,500, and also 27,200 mixed trees taken from those Mr. Thompson had sent for his own use in the contract, and for which, in his bill, he allowed me ten shillings per thousand for planting. From the experience I had bought, I prepared about an acre and a quarter of land for a nursery of my own, and then filled it, in the spring of 1823, with 175,000 three-year and two-year seedling larches, spruce, birch, &c., as appear in the bills annexed from Dunkeld, dated November 1822, January 1823, and March 1823. These became exceedingly fine plants, and of more value to me, from being at hand, and becoming well rooted, than any I could purchase. As these were subsequently removed to the plantations, the nursery was refilled, as will appear by Donaldson's yearly bills, and there are about 300,000 trees in it at present.

In November, 1823, I proceeded to plant twenty-three acres in Rowberries, Nos. 3 and 4; rather more than four acres in Salt-lane grounds: about eight acres on the hills, and eighteen acres in Great Hazards, and two grounds in Pinlands, about fifteen acres. These were not made by contract. I purchased of Mr, Thompson 178,000 trees, as appears by his bill, and I took 30,000 of the best three-year seedling larch from my own nursery, and employed my own labourers to plant them, ploughing the drills as before described. I then filled up all the vacancies a third time in the Rowberries No. 2, with larch from my nursery, all the transplanted Scotch firs, previously planted, having failed. Of the new plantations made in November, 1823, all those succeeded well which were planted with the trees from Mr. Thompson's own ground near Southampton, and with those from my own nursery. Unfortunately, Mr. Thompson not having enough himself, had provided me with 50,000 larch from Bagshot, and 50,000 larch from the New Forest, and here again I experienced a severe and unexpected disappointment. They nearly all died, and I can only account for it from the poor nature of the black sandy soil of the neighbourhood from whence they came, which had not produced a sufficient quantity of small fibrous roots. The ensuing season I put the plough between the rows previously planted, ploughed out fresh drills between the old ones, and replanted the whole with larch from the nursery in that piece, No. 5, to the north, and also No. 6, and the piece Z, by holing, in which those unfortunate trees had been used, and then again went over the whole of the plantations, replacing every failure.

In November, 1824, I planted with larch the Upper Holt piece with 5,000 plants, from Mr. Page's nursery, near Southampton, and with trees from my nursery, in quantity not less than 4,000 to the acre; seven acres of Hazards were planted entirely with larch, and three acres of Hazards were planted under the direction and at the expense of Lady Mary Long, with larch, mixed with Spanish chesnuts, locusts, and planes. The rest of the season was employed in replanting some of the grounds planted by contract by Mr. Thompson, which, after the second year from planting, he did not fill up, and in again, for the fourth time, nearly replanting some of the Rowberries first planted in 1821. Mr. Page's bill will show what trees were purchased of him, and Donaldson's bills will prove what a quantity was constantly bedded in the nursery, to succeed those which the foreman had planted out.

In November, 1825, a piece of ground, in continuation of the plantation on the East-hill, containing about one acre and a quarter, was very thickly planted with all kinds of fir and birch, and the ground was previously sown with acorns and beech mast. This being intended in that exposed quarter to afford shelter to some farm buildings, I was willing to have another trial of the Scotch firs, and for this purpose, and for again filling up the failures on the same hill, I purchased 15,000 Scotch firs of Mr. Page, which were planted under the direction of Thomas Benett, together with a vast quantity of larch from the nursery, in replacing failures.

In November, 1826, about 40,000 larch and spruce were removed from my nursery, and planted chiefly in the first plantation made, and in replacing all the failures in the most exposed spots.

Having mentioned that two pieces in Pinlands, marked I and G, were planted entirely with oak, in 1825 I directed Thomas Benett to plant them thickly between the rows of oak with larch, Scotch fir, and black Italian poplar, to assist in drawing on the oaks, which was done, and I have no doubt will increase their growth upwards.

From this statement it will appear, that from the repeated failures alone, I was each year prevented from becoming a candidate for a medal. By six years perseverance, I am now emboldened to lay the circumstances before you, and to add the certificates of Alexander Forbes and Thomas Benett, as to what they did themselves; and those of persons resident near the spot, to testify that the whole of the plantations are now well filled, and in a thriving state, and likely to produce profitable timber. Before I conclude, I would add, that the plantations I first made, I believe in 1812, and which appeared so sickly for four or five years, having produced me, in very moderate thinnings, abundance of useful poles for fencing, rafters, &c., and that some of the best of them have sold for one shilling and sixpence a-piece. Under the trees there is now a thick crop of young ash plants all over the gronnd, from seed self-sown. Under the shelter of the larch and Scotch firs, in this plantation of six acres, I last year planted a sufficient quantity of oak, four feet high, for a future crop; and to show how well they prosper under the shelter of these trees, and in a soil enriched by the accumulation of vegetable matter from the droppings of the larch, although only one year planted, their leaves were this year as large, and as dark in colour, as if they had never been moved. From experience, I am convinced that oaks of four feet high, planted among firs of from twelve to fifteen years growth, will make a more rapid progress, and be better trees, in a given period, than if they had been planted at the same time with the firs. I have had also a host of enemies to contend with in hares and rabbits, who have cropped the firs almost immediately after planting, and these from my neighbours' woods, which I could not destroy.

It is impossible exactly to ascertain the number of thousands of larch and spruce every year transplanted out from the nursery; but I trust that the bills of Donaldson, Page, and Thompson, will be received as evidence of the number of trees planted and bedded into the nursery.

I have endeavoured to ascertain the total expense of what has been done; and after every care taken to avoid error, to the best of my knowledge, and as accurately as I can make it out, the following appears to be correct. There is a small difference in my account of what I have paid to Mr. Thompson and his bill; as it appears in my books, however, that I have paid him rather more, I trust is of no moment.

Paid.	£.	s.	d.
Messrs. Donaldson	131	12	2
Mr. Thompson	438	7	3
Mr. Page	82	17	1
Alexander Forbes, for labour	185	16	6
Thomas Benett, for labour	177	5	0
Expenses of bedding out in the nursery, weeding, &c. &c.	35	15	0
Fencing, banking, and repairing	44	9	1
Carriage from Scotland, and my team's expenses to and from Southampton with trees.	20	9	11
	1,116	18	0
Add the expenses of the three acres, called Lady Mary Long's plantation	9	9	0
Total	1,126	7	0

Paid by her Ladyship.	£.	s.	d.
Trees from Mr. Page	7	10	0
Paid for labour	1	19	0
	9	9	0

Upon the plan which accompanies this, I have given a particular description of the lands and quantities.

In thus taking a review of what has been done for six years, it is possible some small inaccuracies may have crept in; but I have taken much pains to send as particular and as correct a statement as possible, both as to facts and figures. I send with this (what are, I believe) the usual certificates; and if any further information is required, I shall be happy to forward it to you as well as I am able. After trespassing so long upon your indulgence, I subscribe myself, sir, &c. &c.

A. Aikin, *Esq. Sec. &c.* WALTER LONG.

AFFIDAVITS.

Thomas Benett, gardener to Walter Long, Esq. at Preshaw-house, saith, that he lived as servant to Mr. Long when he first planted, in 1812, or thereabouts, the high plantations of six acres, which are now most prosperous, and that he has remained in his service ever since. That he witnessed the execution and completion of the contract made with Mr. Thompson, in November and December, 1822, and that he can bear testimony that all the trees sent by Mr. Thompson were planted, some in the grounds described in the plan shown to him by Mr. Long, and coloured yellow, denoting the extent of Mr. Thompson's contract, and also some by Alexander Forbes, in filling up vacancies in the plantations made in 1821. That he well knows every piece of ground so planted, and that the plan describes each of them correctly. That in November, 1823, he, with some labourers, was employed in replacing all the failures in the land called the Rowberries, No. 2, and for that purpose he removed a great many thousands of larch from Mr. Long's nursery, but how many he cannot exactly recollect. That in November, 1824, he commenced superintending the whole on a large scale, as Alexander Forbes had done before him. That he planted eleven acres of land, called in the plan Upper Holt Ground, coloured red, with 5,000 larch from Mr. Page's nursery, near Southampton, and with 40,000 larch from Mr. Long's nursery; and ten acres in Hazards, seven acres of it entirely with larch, and three acres with larch mixed with Spanish chesnuts, locusts, and planes. These last three acres were called Lady Mary Long's Plantation; her ladyship having taken the whole management and expense upon herself. To effect this (*exclusive* of the said three acres, for which there was a separate bill and account), 105,000 larch were purchased of Mr. Page, in addition to what trees were fit to be removed from Mr. Long's nursery. About 40,000 of these, and 1,000 from Mr. Long's nursery, were planted in this last ground of seven acres. Thomas Benett moreover saith, that he planted 36,000 larch from the nursery in the vacancies that had occurred in Rowberry, No. 1; that out of the nursery he replanted with larch, in drills ploughed between the former planted rows, the piece on the hill to the most northern point, marked 5 in the plan; that with the residue of the 100,000 larch from Mr. Page, he made out all the failures everywhere throughout the Pinlands and Hazards, and also replanted with them, in drills, a field, marked N, and coloured yellow; and with 15,000 more larch from Mr. Page, he replanted, in drills between the old rows, the two pieces in Salt-lane, also coloured yellow, which three last-mentioned pieces had been planted by Mr. Thompson in his contract, but were not sufficiently filled with trees, from the numerous failures. The two last pieces are marked H and W. In the same season he also planted 1,000 large larch, and 2,200 black Italian poplars, in the two grounds, G and I, coloured yellow, previously planted with oak only. To these he added some spruce firs, and in the following season a quantity of Scotch firs, to shelter and force up the oaks. That in November 1825 he planted three acres on the north hill in Corhampton parish, left white on the plan, very thickly with Scotch firs, larch, and birch, the two latter from Mr. Long's nursery, and previously ploughed the whole of the land, and sowed it well with acorns and beech mast, some of which are come up and growing well; and that afterwards he again went over the whole of the plantations, and consumed an immense quantity of larch out of Mr. Long's nursery in making good the failures. That in December, 1826, he, with a number of hands, was wholly employed in planting out from the nursery larch and spruce in great quantities over all the plantations on the hills, more especially in the semicircular piece of thirteen acres, coloured half lilac and half yellow, in Corhampton, in the piece called Upper Holt Ground, coloured red, and in the piece first of all planted, coloured pink; the latter of which being so much cropped by hares and rabbits he was obliged almost to replant entirely. Thomas Benett further saith, that he has from year to year, since 1823, bedded-in all the plants that came from Scotland, and that the number generally exceeded the quantity named in Messrs. Donaldson's bills. That he has been for three or four years also employed in making numerous ornamental clumps of planting about the park at Preshaw, and in transplanting large trees out of the full-grown plantations and woods, and also ornamental thorns, in which he has been generally successful; but such works are not considered to belong to the extensive plantations herein-before described. And he further saith, that at present his time is much employed in constantly visiting the said plantations, to see that the fences are in good order, and that no cattle are about to get in.

(Signed) His ⋈ mark, THOMAS BENETT.

Sworn before me ,one of his majesty's justices of the peace forthe county of Southampton, this 26th day of January, 1827,

GRIFFITH COLPOYS.

Alexander Forbes, now bailiff to Richard Shute, Esq. of Blackdown, in the county of Hants, states, that in the year 1820 he was living in the county of Forfar; that he was there engaged by Walter Long, Esq. to go to Preshaw-house, in Hampshire, to plant for him; that in the following January and February he planted for him, in a piece of land in Rowberries, marked pink in the map, 12,000 larch seedlings, and 13,000 spruce and Scotch fir seedlings, which had arrived from Scotland; that he planted them with a triangular pointed spade, merely niching them into the ground. Also, that in January and February, 1822, he, with some labourers under him, planted 150,000 seedling larch in the lands, coloured lilac in the plan, consisting of five pieces, and about thirty-three acres of land. That in consequence of the very numerous failures in these plantations he, in November and December, 1822, filled up the whole of these plantations with the pinaster seedlings, Scotch fir seedlings, and transplanted Scotch fir, beech, and birch, which were sent by Mr. Thomson, the nurseryman; and in the three acre piece, near Salt-lane, he planted a second time larch, sycamore, spruce, beech, and ash; he does not exactly recollect the number of trees used by him, but he remembers that very many thousands were sent for his use in this work, and that those not being sufficient, he had several thousands of the transplanted trees from the bundles which Mr. Thompson had sent for his own contract. He perfectly remembers the contract entered into by Mr. Thompson, and that all the lands coloured yellow in the plan were planted by him with trees, some three, and some four feet apart, under the superintendance of a foreman named Sparry, and the whole contract completed. That in November, 1823, he was employed by Mr. Long, with sixty or eighty labourers, to plant the two pieces of the Rowberries called Downpiece and Fisher's Down; also two pieces on the hill, marked 5 and 6; also a piece of ground near Salt-lane, marked Z, Great Hazards, and two pieces called Inner and Outer Pinlands, D and C on the plan, all coloured brown; that he and the men under him planted in these grounds, containing about seventy acres, according to the best of his recollection, not less than 162,000 larch, 10,000 spruce, 5,000 oaks, and 1,000 Spanish chesnuts, besides about

80,000 fine three-years old larch, which were taken from Mr. Long's nursery, and which he had himself bedded into the said nursery the spring preceding. He also bedded into the nursery all the seedlings which arrived from Scotland in the years 1822 and 1823, the account of which appears in Messrs. Donaldson's bills. That in December, 1824, he was employed in making good numerous failures in the Lower Pinlands, and in the corner-piece, marked No. 6, in Corhampton parish to the north-east. That he has since left Mr. Long's service; but that at the time of making this statement he has viewed the whole of the plantations, and can report them to be now well filled with thriving trees, and well fenced from cattle; and that, on the average, he considers there are, *at least*, 4,000 prosperous trees on each acre.

ALEXANDER FORBES.

Sworn before me, one of his majesty's justices of the peace for the county of Southampton, this 26th day of January, 1827,

GRIFFITH COLPOYS.

Preshaw, January 26, 1827.

We, the undersigned Richard Mills and William Goddard, do hereby certify, on oath, that, on the day preceding the date hereof, we viewed the whole of the lands planted by Walter Long, Esq., and we do report that the whole of the plantations have been well filled up, and are now full of young healthy trees of various kinds, and in a thriving state, likely to produce profitable timber, and that they are well fenced in, and secured from cattle.

RICHARD MILLS, Yeoman, Beauworth.

WILLIAM GODDARD, Land Surveyor, Kilminster.

Sworn before me, one of his majesty's justices of the peace for the county of Southampton, this 26th day of January, 1827,

GRIFFITH COLPOYS.

XXIV.—*On the Manufacture of the Cologne Yellow, as substitute for the Chromate of Lead.* By M. BOUTRON-CHARLAND*.

THE discovery of the chromic acid is one of the finest which chemistry has made during the last thirty years; but the dearness of this product has for a long time limited its use; and, notwithstanding the various manufactories established for its fabrication, it is still of too high a price to be employed in the production of those paints or colours which should unite a facility of laying them on the work with a solidity of colour.

This new product possesses these two desirable qualities; it is sold in Paris under the name of *poudre de Cologne;* after many essays, it is found that 10 grammes of this substance contain 1,95 of sulphate of lead, 6 of sulphate of lime (gypsum), and 2,5 of chromate of lead, composed of 1,63 of lead, and 587 of the chromic acid. By the analysis, it could not be ascertained whether this powder was formed by a simple mixture of its component parts, or whether it was a true combination.

After examining this powder with considerable attention, the idea occurred to the author of this article, that the sulphate of lime which it contained in such large proportion, was only impregnated with a small quantity of chromate of lead. In making an experiment, he effected the decomposition of the sulphate of lime and chromate of lead, by a solution of sulphate of soda (Glauber's salt), and the neutral acetate of lead, and a precipitate was instantly formed of a very fine colour, and which only differed from the yellow powder of Cologne by its lesser density. This difference in the weight induced the author to mix the sulphate of lime, in the state of a very fine powder, with a solution of chromate of potash, and precipitate it by means of the neutral acetate of lead, and he thus formed an exactly similar product. The powder obtained by this last process differed in no respect from the Cologne yellow.

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* From the *Jour. de Pharm.* 1827; and re-published in Ferussac's *Bulletin des Sciences Technologiques* for Jan. 1828.

XVX.—*On the Manufacture of British Leghorn Plait for Hats, Bonnets, &c.* By *Messrs.* J. *and* A. MUIR*.

SIR, *Greenock, Feb.* 10, 1827.

WE have by coach forwarded for the competition a paper parcel containing fifty score rye plait, in imitation of Italian. We also, on the 4th forwarded to Mr. Jones, of the house of Ingleby, Jones, and Co. one box, containing ten dozen ladies' hats made from the same material: we have requested that he provide you with the whole or what part you wish. We hope both packages will be in time, so that we may be enrolled as competitors. We have not, since our former communication, made any alteration either as to material or mode of bleaching. We do not think a better material can be procured than rye for that purpose. It grows in much finer and longer joints than wheat, and with it we produce finer hats than come from Italy. Last spring we had forty bolls of rye sown for straw, which was put in five or six Scotch acres. Our agent finds, from experience, that the ground requires to be rich. He has made for us in the course of last year two thousand ladies' hats, besides several thousand scores of plait that was forwarded to us to be made up into hats here or sold in the plait.

We are, sir, &c.

A. AIKIN, *Esq. Sec.* JAMES & ANDREW MUIR.

SIR, *Greenock, Feb.* 12, 1827.

We have this day received yours of the 9th. We had wrtten to Messrs. Ingleby, Jones, and Co. on the 26th August last, with an order to receive from you our medal and hats, which we thought were since in their possession: you will now please deliver the same to them.

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* From Vol. XLV. of the Transactions of the Society for the Encouragement of Arts. Manufactures, and Commerce. The society voted the sum of twenty guineas to Messrs. Muir and Co.

In the course of the past year we have corresponded with Sir John Sinclair, Sir James Riddell, and several others on the subject of the manufacture of hats in imitation of Leghorn. Sir James Riddell has engaged a man in our employment for the purpose of attempting the manufacture on his estate.

Owing to the great depression in business, Leghorn hats have been sold so much lower than formerly, that though our workers are only earning two shillings to two shillings and sixpence a week, we find difficulty in producing goods to leave us a profit; a knowledge of this, we suppose, has been the means of preventing those houses in England, who are in the habit of dealing in straw plait and hats, embarking in that manufacture. That plait and hats can be produced in this country equal in quality to the foreign, is now, we think, beyond a doubt. When Messrs. Ingleby, Jones, and Co. have advised us of the house they have fixed on to sell our manufacture, we intend this spring to forward to London all the finest hats, as we receive them from Orkney. In the course of eight days we intend forwarding more hats and plait to London, which, in point of clean work, will be generally superior to those hitherto sent.

We are, sir, &c.

A. Aikin, *Esq. Sec.* James & Andrew Muir.

SIR, *Wood-street, Cheapside, London, Feb.* 28, 1827.

At the request of Messrs. James and Andrew Muir, of Greenock, we hand you four British Leghorn hats, which you will be pleased to submit to the Society of Arts. These hats are made in the Orkneys from rye-straw, prepared in the manner they formerly described, and appear of excellent quality.

We are, sir, &c.

A. Aikin, *Esq. Sec.* Ingleby, Jones, & Co.

SIR, *Greenock, March* 17, 1827.

We received your favour of the 13th instant, advising the society's having voted to us their large silver medal or twenty guineas, at our option (being the premium offered), for our hats of rye straw, in imitation of Leghorn.

It has given us pleasare to learn from your's, that our plait is tighter and more compact made than that in Italy. Our Orkney plaiters, when at split straw, always made better work than that in Bedfordshire, and naturally followed the same method in rye plait; the Italians, however, by slighting their work, are able to bring it much cheaper to market. So very low are Italian hats just now, that, notwithstanding the duty, we have difficulty in making a saving business in our manufacture. This is the grand reason why there is not a greater competition. If government were to double the present duty on Italian plait and hats, we have no doubt but by so doing much employment would be given to our female population, and many acres of poor land would be put into cultivation.

With respect to knitting, our plait, owing to its compactness, could not be made up in the same time as Italian. For example, take what is called a forty-row Italian hat, and a forty-row hat of ours, count the loops with an inch glass in each, ours will count twenty-two loops, while the Italians will count only nineteen loops, thus making a difference of fifteen per cent., which operates both as it respects plaiting and knitting; but ours will be a finer looking hat, with the same number of rows. Our knitters were taught to take up one loop at a time, and continue that practice, yet our plait admits of the knitters taking up three or more loops without injuring the appearance of the plait. We are, sir, &c.

A. Aikin, *Esq. Sec.* JAMES & ANDREW MUIR.

P. S.—We might have said, our hats, with the same number of turnings to the inch, can be made up as soon as the Italian. We intend to forward to the society a gentleman's silk shag hat, weighing only six ounces, the whole of rye-straw, knit and plait as the Italian hats, an invention of ours that is much approved of by gentlemen who have worn them; also a piece of plait, the finest we have ever made, it would make a hat equal ta eighty rows, or ten to eleven rows, in the inch. We have sent to different houses in London this spring, eight hundred and eighty score rye-plait, and we have about one thousand score to forward.

XXVI.—*On protecting early Crops of Turnips from the Fly. By Mr.* CARLES POPPY, *Jun. of Witnesham, near Ipswich.*[*]

IN December, 1825, a letter was received from Mr. Poppy in consequence of the premium offered by the Society to the inventor of an effectual method of protecting turnip crops from the fly. This letter occasioned a desire on the part of the committee to whom it was referred, for further particulars; and thus was begun a correspondence between Mr. Poppy and the secretary, which continued for about a year and a half, and occasioned the interchange of numerous letters. It has not been thought necessary to print these at length, as it appeared that the object of the society, the communication of useful information, would be better answered by disencumbering the useful facts of the repetitions and mutual explanations incident to a protracted correspondence.

The turnip fly is a small insect, which abounds, more or less, on the rank verdure of hedge-banks during the whole open time of the year, and spreads from thence on such agricultural crops as are grateful to it. Turnips are particularly exposed to its attacks while the young seedlings are yet very tender; but when they get into the rough leaf, they are, for the most part, secure from the attacks of this insect.

It is a general opinion, that the fly has been more prevalent, or at least more destructive, of late years, than it used to be, and this Mr. Poppy (admitting the fact) attributes to the circumstance, that the turnips at present cultivated are finer in the tap root and in the herbage than they used to be, so that the seedlings continue longer in that state in which they form an agreeable food for the fly.

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[*] From vol. XLV. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce, just published. The society voted its gold Ceres medal to Mr. Poppy.

It is considered as a fact well ascertained, that when the turnip lands on a farm are sown in succession, with intervals of a few days between the sowing of each field, the crop suffers more than when the whole of the turnip lands are sown at once; the insects, in the former case, migrating from the field first sown to the next in succession, so that each field in turn is preyed upon by nearly the whole number of insects on the farm. On this account Mr. Sutton proposed that all the turnip lands of a district should be ploughed, rolled down, and then sowed on one and the same day, after the first shower of rain. This would, no doubt, be, to a certain degree, effectual, but is often impossible to carry into execution even upon a single farm, much more on an entire district.

It had been observed, that on those spots in a field where a greater quantity of seed than usual had been accidentally scattered, the plants, in consequence of being much crowded, drew each other up, like mustard sown for small salading, and in consequence of this, were more tender and succulent than the rest of the crop. The patches were found to be particularly infested by the fly, which suggested to Mr. Paul, of Starston, in Norfolk, the idea of sowing a number of such patches, by way of decoy to the insects, and when collected in these places, they were to be destroyed by a heavy roller, or by scattering straw over them and burning them, or by any other means. The success attending this practice was very dubious, which induced Mr. J. Hayward, of Stoke-Ash, and Mr. Samuel Taylor, of Ditchingham, both of them friends of Mr. Poppy, to sow the whole land unusually thick, in order that there might be plants enough to supply the insects, and also to stand for a crop. The success attending this practice was considerable, although it occasionally failed; but the plants, in consequence of the thick sowing, having been drawn up too weak, their subsequent growth was retarded, and the value of the crop deteriorated, it being well known that a large full grown turnip is of more value as cattle food than two or three smaller ones of the same weight.

Mr. Poppy, while he has adopted the practice of thick sowing, in order to decoy the fly, has avoided the injury to the crop arising from the plants being drawn up too weak, by drilling the seed in rows at only half the usual distance, and sowing thick the alternate rows for a decoy, while the other rows are sown thin, being intended to stand for a crop. The fly appears to prefer the white turnip to the Swedish turnip, so that a crop of this latter may be got with certainty, as far as security from the fly is concerned, by sowing thickly the rows intended for a decoy with white turnips. For this latter purpose, the seed obtained from untransplanted roots will answer perfectly well. When the turnips intended for the crop are ready for the first hoeing, the rows intended for a decoy, to which the fly chiefly confine themselves, are to be turned in with the horse hoe.

In corroboration of his theory, Mr. Poppy, in 1826, drilled four acres with a pint of Swedish turnip seed for the crop, and with about a peck of the commonest white turnip seed for a decoy. The plan fully answered his expectation, the flies, which were very numerous, feeding almost entirely on the thick sown rows, so that he obtained an excellent crop, while those of his neighbours, sown at the same time, and in the ussual manner, totally failed.

He was also requested by a friend to undertake the management of four acres of ground which, under the common management, had always failed to produce a crop. Mr. Poppy complied with the request, although, as the farm was managed by a bailiff, it was not a very agreeable business. Not a drop of rain fell after the sowing, but, nevertheless, an excellent crop was obtained.

XXVII.—*On the different Black Colours. By the late celebrated* William Lewis, *M.B. and F.R.S.*

(Continued from page 60.)

Of the Dyeing of Woollen Black.

I. *General Observations on the Black Dye.*—13. The proportions of the ingredients to one another are regulated on quite other principles than in inks. Equal parts of vitriol and galls seem to be the best proportions. If the galls are much increased, which it is necessary they should be for ink, they make the dye incline to brown, but an increase of the vitriol, by which inks are made so perishable, does not appear at all to affect the dye; even the largest additions of vitriol, however they may weaken the cloth, do not seem to injure the colour.

14. In the dyeing of black, as of most other colours, there are considerable variations in the practices of different workmen, which it would be difficult, and even useless, to collect. I shall here describe two processes, which I have often tried in small, and which appeared to me to be the best.

II. *Black with Galls, Logwood, and Vitriol.*—A hundred pounds of woollen cloth dyed first to a deep blue, require for the black dye about five pounds of vitriol, five of galls, and thirty of logwood. These, as I am informed by an experienced artist, are the quantities generally allowed by our dyers.

The galls, beaten into a moderately fine powder and tied up in a bag, are boiled for a little time in a copper of water, sufficient for working the cloth in. The black cloth, after being steeped in river water and drained, that it may be everywhere thoroughly moist, but not so as to drip, is in this state put into the boiling decoction of the galls, and kept turning therein for two hours or more, the bag of galls being now and then squeezed, that the virtue of this drug may be more effectually extracted and communicated to the cloth.

The logwood, rasped or shaved into small chips, or rather ground into powder, is boiled in another copper, this wood giving out its colour exceedingly difficultly. The logwood liquor is most commonly prepared a considerable time before it is used, its colour being found to improve in keeping.

The logwood decoction being made of a scalding heat, but not quite boiling, the vitriol is thrown into it; and as soon as this is dissolved the galled cloth is put in. A boiling heat should never be used after the addition of the vitriol, not only as it would needlessly augment the corrosive power of the salt, but likewise as it would injure the beauty of the colour, by hastily extricating part of the ferruginous matter of the vitriol in an ochery form before it can come sufficiently in contact with the astringent substance with which the cloth is impregnated. The cloth is incessantly turned in the liquor, that it may receive the colour uniformly, and now and then taken out and aired for a moment, which contributes to secure the colour, and at the same time affords an opportunity of judging of its deepness.

After about two hours continuance in the dye the cloth is found to have received a good black, and is then taken out, washed with cold water, and passed through the fulling mill. The superfine cloth is three times fulled with warm solution of soap, which not only discharges the superfluous colour that would otherwise stain the skin or linen, but contributes also to soften the cloth itself by mortifying the acid.

III. *Black Dye, with Verdegris.*—For some of the superfine black cloths a little verdegris is used by our dyers, and this addition appears among the French to be more frequent. M. Hellot, after trial of sundry processes, gives the following as being the best, or as that which produces the finest velvet black on cloth, and which accordingly is followed in the best dye-houses in France:—

For a hundred pounds of blue cloth ten pounds of logwood chips and the same quantity of Aleppo galls in powder are tied up together in a bag, and boiled in a middling copper, with a suitable quantity of water, for twelve hours.

One third of this decoction is taken out into another copper, and two pounds of powdered verdegris added to it. In this mixture kept gently boiling, or rather only scalding hot, the cloth is dipped and turned without ceasing for two hours, after which it is taken out and aired.

Another third of this decoction is laded out into the same copper, eight pounds of green vitriol added, and the fire slackened about half an hour. The vitriol being now all dissolved, the cloth is put in and worked for an hour, and then taken out and aired again.

The remaining third of the decoction in the first copper is then put to the other two in the second, the bag of galls and logwood being well pressed out. Fifteen or twenty pounds of sumach are now added, and as soon as the copper begins to boil two pounds more of vitriol are thrown in with some cold water to slacken the heat. The cloth is kept in for an hour, then taken out and aired, dipped a second time, and kept turning for an hour longer.

The cloth now completely dyed is washed in a river and scoured in the fulling mill till the water comes from it colourless. It is then passed through a copper of weld, prepared as for dying yellow, which is supposed to soften the cloth and fix the colour.

This process affords a very fine black, but it is too expensive to be followed by our dyers, the fire and manual labour of the black dye, as here described, amounting to more, as I am informed by a person conversant in this business, than the dyer is paid for the whole dye of the above quantity of superfine cloth, including the blue ground. The quantity of vitriol and galls may be diminished, and the time of boiling greatly shortened. The passing through weld liquor after scouring with soap is entirely unnecessary, though, probably, it may be of use where the scouring is not complied with: not, however, in virtue of the weld itself, but of the alcaline salt, with which the decoction of it is generally prepared by the dyers, so that the weld liquor does no more than supply the place of soap.

Both in this and in the foregoing process the liquor remains black after the dyeing of the cloth is finished, and communicates a dilute black, that is a grey colour, to as much fresh cloth as can be conveniently worked in it.

(*To be continued.*)

LIST OF PATENTS FOR NEW INVENTIONS,

Which have passed the Great Seal since Jan. 26, 1828.

To John Weiss, of the Strand, in the county of Middlesex, surgical instrument maker; for certain improvements on instruments for bleeding horses and other animals. Dated Jan. 26, 1828.—To be specified in six months.

To Augustus Applegarth, of Crayford, in the county of Kent, printer; for certain improvements in block printing. Dated Jan. 26, 1828.—In four months.

To Donald Currie, of Regent-street, St. James's, in the county of Middlesex, Esq., who, in consequence of a communication made to him by a certain foreigner residing abroad, is in possession of a method of preserving grain, and other vegetable and animal substances and liquids. Dated Jan. 31, 1828.—In six months.

To William Nairn, of Dane-street, Edinburgh, in the county of Midlothian, mason; for a new or improved method or methods of propelling vessels through or on the water by the aid of steam, or other mechanical force. Dated Feb. 5, 1828.—In six months.

GILL'S
TECHNOLOGICAL REPOSITORY.

XXVIII.—*On the Microscope.* *By the* EDITOR.

WITH A PLATE.

(Continued from page 148.)

Mr. T. Carpenter's experiments on the Compound Eyes of Insects, and the Crustaceous Animals.—An eminent philosopher of the present day, having asserted that these organs were not eyes, nor adapted for vision, and his opinion having been countenanced by other scientific men likewise, Mr. Carpenter took the opportunity lately, on being visited by several of our most eminent men in the world of science, who were attracted by our mentioning his having completely succeeded in exposing to view the two sets of teeth and jaws of the mite, to show them the preparations he had formerly made, with a view to the complete developement of the wonderful structure of these eyes; and they were so much surprised and convinced of their being perfect eyes, that they requested he would communicate the results of his inquiries to a certain high quarter, where they would be most acceptable, and no doubt be published. However, he has chosen to make our work the vehicle by which to communicate his observations to the public, and with this view has kindly gratified us with a sight of his beautiful objects, as prepared by him for the microscope, as well as also furnished us with many particulars of his method of operating in their dissection.

In general, persons content themselves with merely clearing the cornea of the compound eye of all its inclosed parts, and cleaning it thoroughly, so as to render it an interesting transparent object for the microscope; totally neglecting those more wonderful interior parts, of which we shall treat presently.

These compound eyes are either arranged in an hexagonal manner, like the cells of a honeycomb, or else in squares; and even in some cases, both in squares and hexagons. We have already mentioned the perfect cast he has taken from the compound cornea of the eye of a cerambyx, in a solution of gum arabic in water, and the distinctness with which his cast shewed the images of objects in each separate lens composing it, in our last number, page 144; so also the eye itself, when viewed in the microscope as an opaque object, presented in each lens the perfect image, by reflection, of the illuminating metal speculum, and also of the forceps, and the slice of cork on which the eye itself was mounted; a convincing and satisfactory proof of the astonishing accuracy with which it was formed by its Almighty Creator, and evidently with a view to its great utility to the cerambyx which bore it. In like manner, when viewed as transparent objects, these compound corneas gave perfect images of the flame of the lamp in each of their lenses. Mr. Carpenter, however, in dissecting the cornea of the compound eye of the dragon fly, saw that it was formed of several distinct lamina, or thin plates, like the coats of an onion, for instance, and he therefore steeped it for several days in water to soften it, after which, by carefully rubbing it between his fingers and thumb, he succeeded in separating the lamina, until he came to the innermost, and thus obtained a beautifully pellucid object for his microscope; it, (as well as all the other coats) exhibiting the perfect images of objects in all the numerous lenses of which it was composed. The lenses in each of the various laminæ composing the two eyes, amounted, at the least, to the enormous sum of ten thousand! He also dissected the compound eyes of moths and butterflies, and found the compound eyes of those insects formed in a similar manner. One of the large hawk-moths had upwards of forty thousand divisions in the corneas composing its two eyes, both of which were composed of five distinct plates or lamina, each plate being studded also with as many lenses, so that by multiplying forty thousand by five, it will appear that there are two hundred thousand lenses in these two compound eyes.

The compound eyes of water-beetles are much more convex than those which inhabit the land and air, agreeing with the difference of the medium they live in; and in the boat-beetle, a large water insect, although in general they are hexangular, yet some of them are square; and these latter have a less magnifying power than the hexagonal ones.

Under the lower, or innermost plate of the cornea, is placed a very fine reticulated membrane, full of blood-vessels, and which covers the whole superficies of that plate; and immediately under this membrane there are as many tubes as there are lenses in that lamina. In the eyes with hexagonally shaped lenses, these tubes are also hexagonal; but in those formed of squares, the tubes are likewise square. This latter structure takes place in the compound eyes of many of the crustaceous animals, such as the large French cray-fish, the river cray-fish, the lobster, the prawn, and the shrimp; and as the parts are on a comparatively large scale in the French cray-fish, so Mr. Carpenter has made their dissection the peculiar objects of his study; and his description of them will serve to elucidate the construction of the smaller kinds, which, as far as his observations have extended, have a similar formation.

The eyes of the French cray-fish are formed in masses of an irregular oval shape, and are posited upon the summits of short crustaceous tubes. The eyes he has operated upon had been previously boiled, but which circumstance, notwithstanding, did not prevent him from discovering their wonderful structure, although the humours in them had become opaque in consequence thereof.

The series of tubes in these eyes are square, and nearly parallel throughout their entire length, which is of several times their diameter, differing, however, in this respect, accordingly as they were posited towards the centres, or towards the edges of the eyes; they being longest near the centres, and shortening towards the edges. Each of these square tubes has a minute elevated spot in its centre.

The general appearance of the mass of tubes resembles that of the seeds in the disc of the sunflower, and they rest upon another layer of lenses, each lens being also capable of affording the image of any object placed before it; so that in fact, it would appear that each distinct eye, with its combinations of lenses in the cornea, the tube, and the single lens just described, is, in reality, *an acromatic telescope*, a most wonderful combination indeed!

Swammerdam, in his general history of insects, has shown dissections of the compound eye of the bee, which has hexagonal pyramidal tubes placed under the membrane next to the cornea, and terminating at their opposite ends in *minute points*, by which they are affixed to a membrane similarly posited with the layer of single lenses above mentioned. But it is difficult to conceive that lenses can be formed therein, as there is no space afforded at the minute point of each hexagonal pyramidal tube for their reception. Possibly Swammerdam may not have attended with sufficient accuracy to this part of the dissection; and Mr. Carpenter intends shortly to dissect the eye of the bee himself, when he will have an opportunity of confirming or refuting the observations of Swammerdam.

Immediately underneath the layer of single lenses, bundles of optic nerves are found, one for each lens, and gradually lessening or becoming thinner as they proceed towards the brain of the animal.

Mr. Carpenter has transparent objects, formed of thin slices cut through this compound eye, and placed between two glass slips; as well as parts of the dissected eyes preserved in spirits of wine, and having minute entomologist's pins inserted in them, by which they can be readily held in the forceps, and then be viewed as most pleasing and interesting opaque objects; or otherwise the pin may be stuck into a small slice of cork, made black on one side and white upon the other, and the slice of cork itself be held in the forceps, and which, indeed, is Mr. Carpenter's own method of viewing them, the slice of cork serving as a screen to preserve the eye of the observer from the bright glare of the flame of the lamp.

In plate iv. fig. 1, represents one of the above-mentioned slices, highly magnified. *a a* is the compound cornea: *b b* the square parellellograms or tubes; *c c* the layer of single lenses; and *d d* the optic nerves. Fig. 2 represents three of the tubes, shewn separately; and fig. 3 exhibits a mass of the tubes *b b* resting in their places upon the layer of single lenses *c c*, under which the optic nerves *d d* are posited.

On procuring collections of Wheel Animalcules, for convenient examination in the Microscope.—The Editor was lately presented by Mr. John Cuthbert with a small test tube, about three-eighths of an inch in diameter, and three and a half inches in length, such as is used in chemical analysis, in which such a numerous collection of that highly interesting object, the wheel animalcule had accumulated, that frequently twenty at a time might be seen adhering to the inside of the glass in the field of view.

On inquiring of Mr. Cuthbert how he managed to form such a numerous collection in so small a space, he said, that by the advice of Dr. Goring, he kept them in *rain-water*, now and then putting into the glass *a little* cut stems or leaves of hay, but *not so much* as is usual; and that they bred so fast, that those he gave the Editor were produced in about two months' time.

On the Microscopic Kaliedoscope.—The Editor is induced to give this name to the mixture of three salts in solution, mentioned by him in vol. 1, page 29, in consequence of the ever-varying, regularly-arranged, and beautiful combinations which continually present themselves to the eye of the observer in the microscope, during the exhalation of the water in the drop around the interior of its edges, until the whole of its surface is covered, and which, indeed, keeps the observer on the alert during the entire progress of the evaporation, to keep pace with them.

There is not the least doubt but that a skilful and rapid draughtsman might avail himself of this continued succession of symmetrical figures, to seize upon and preserve many of their exquisite forms as aids to his fancy, in designing new and elegant patterns for chintz and calico printing, as also for the manufacture of paper-hangings, &c. &c.

Unfortunately, however, there is no possibility of preserving the configurations themselves, the combination of salts being deliquescent.

There enters into this combination potash, soda, and ammonia; and the boracic, tartaric, and muriatic acids, all of which seem to be essential to its action, as the figures present themselves with great clearness to the view, without any confusion or intermixture of different kinds upon the same part of the drop; and, indeed, it will always form a most interesting part of the Editor's *demonstrations* on the uses of the microscope; but it is evident, that as it can only be seen by the party using the microscope, so it cannot be rendered available to a numerous audience, but must always remain confined to the few individuals forming a class, and for whose use as many microscopes must be provided as there are persons constituting the class.

The Editor is glad to find that his term *demonstrations*, which has hitherto chiefly been confined to the mathematics, or to the study of anatomy, is now likely to be more extensively adopted; Professor Brande and Mr. Faraday having announced their lectures and *demonstrations* in chemistry, at the Royal Institution, as being now commenced.

On an extempore object for the Microscope.—The Editor finds, that the exceedingly curious downy covering of the stock-gilliflower, discovered by him, and described in vol. i. page 18, of this work, and of which a figure is given in plate I., retains its singularity of figure in the dried specimen of that plant, and only requires a small portion of a leaf, &c. to be placed between two slips of glass wetted with water, and to be slightly rubbed, in order to show the down upon them, and which may thus be often separated entirely from the skins and other parts of the leaf, so as to exhibit its branching ramifications, its foot-stalk, &c. most perfectly.

The skins of the leaf also will thus prove beautiful objects, exhibiting the curious wavy lines intersecting them, the air-cells on the skin of the underside of the leaf, &c. &c.

On the beautiful Configurations of Muriate of Soda (common salt) described in our last number.—The Editor, pursuing his discovery of the configurations formed in solution of the muriate of soda, in viscid mediums, which prevent it from shooting into crystals, has been able to produce a vast variety of them, according to the nature of the different vehicles employed; and as they have excited great interest and surprise in those scientific individuals to whom they have been shown, so he has thought it desirable to exhibit a few of them in plate iv.

They mostly commence with lines crossing each other, and either at right angles, or at acute and obtuse ones, from which ramifications extend themselves around; sometimes these lines are straight, at others curved; thus, in fig. 4, of plate iv, a straight line is seen crossed by a curved serpentining one, and expanding at one end of it into two other curved ones. Fig. 5, is another modification, consisting of two curved lines crossing each other, and figs. 6 and 7 of two others; but the most beautiful of all is that endeavoured to be shown in fig. 8, which, however, affords but a very imperfect idea of the singular elegance of the configurations themselves; and, indeed, they must all of them be seen, in order to be able to form any adequate conception of their manner of ramifying and extending themselves on all sides.

On Mr. T. Carpenter's Microscopic display of the internal parts of the Head of a Gnat.—Mr. Carpenter, having carefully denuded the head of its external parts, laid it between two slips of plate glass, and closed them together by tying a pack-thread around them, having previously placed a little thick gum-water between the glasses at each end of them. On leaving them to dry, he found, on removing the twine, the head most beautifully displayed; its internal parts being so perfect that an expert anatomist of his acquaintance was able to distinguish and name the different parts of the brain, muscles, &c. in it with great facility.

It affords a most interesting object for the microscope, when viewed under powerful magnifying powers, and around it several crystals of salts have formed themselves from the juices squeezed out of it.

On Mr. T. Carpenter's Microscopic display of the Insect called the Lady-Bird, in its different states of existence.— This insect deserves attention from it being the natural enemy of the aphis, or the fly which commits such extensive devastations in hop grounds. The lady-bird in its larva state, very quickly exhausts the aphis of its juices, and thus destroys great numbers of them in a very little time; their breed ought therefore to be encouraged as much as possible.

The lady-bird is, in its first stage of existence, a small shining black caterpillar, marked with yellow bands across, which also extend to the colour of its legs, where the yellow bands exist. It in process of time changes to a chrysalis, being enclosed in an external case, very much like a mummy, and in about ten days afterwards changes to the perfect fly so well known. Mr. Carpenter has specimens of this insect in all its various stages of existence, ready mounted as opaque objects for his microscope; and the Editor has long had one of its elytra, or the covers of the wings, placed between talcs in a slider, to be viewed as a transparent object; the veins and arteries so conspicuous in it, forming a most beautiful sight indeed. However, although the aphis finds in the lady-bird a most powerful enemy, yet in the ant it has as great a friend. Mr. Carpenter happening once to beat down a number of aphides out of a stunted oak-tree, at the foot of which was an ant's nest, was very much surprised at seeing soon afterwards the ants busily employed in carrying up the aphides, and carefully replacing them again upon the leaves of the tree, they feeding upon the honey-dew, which it is well known is produced by the aphis.

On the Compound Eyes of the Menelaus Butterfly.—Mr. Carpenter has the cornea of one of these eyes cleared of its internal parts, and mounted between slips of glass as a transparent object. The appearance of it is very peculiar, the lens part of each of the eyes only occupying the centre of each cell of the hexagonal framing, into which the compound eye is divided, the remainder of each cell being a plane.

On the Turnip-Fly.—Mr. Carpenter reading in our last number Mr. Poppy's judicious mode of securing fields of the Swedish turnip from the ravages of this insect, by sowing the common white turnip thickly as a decoy for them, took the opportunity of showing the Editor one of these insects in his microscope.

This fly is in fact a very small *beetle*, with shining elytra, marked with broad longitudinal stripes of black and yellow, and indented all over with small depressions in spots.

(*To be continued.*)

XXIX.—*On an improved Mangle invented by Mr.* J. THURRELL*.

WITH FIGURES.

SIR, *2, Little King-street, Camden Town, March 27,* 1827.

I WILL thank you to lay before the Society of Arts, &c. the accompanying model of a new and simple method of producing the alternating motion of a mangle-box, by turning the handle continually in one direction only.

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* From vol. XLV of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

I am, sir, &c. &c. &c.

A. Aikin, *Esq., Secretary, &c. &c.* JONAS THURRELL.

References to the figures.—Plate V.

Fig. 1, *a a* the mangle box; *b b* parts of the frame which support the axis *c c; d* the cranked handle; *e* and *f* two barrels loose on the axis *c c;* to the barrel *e* are fastened two cords, one of which after making several coils round the barrel, is also delivered from its *under* side to the eye *h,* where it is secured; while the other after having in like manner coiled round the barrel, is also delivered from its under side to the eye *g.* To the barrel *f* are also fastened two cords, which being delivered from the *upper* side of the barrel, are respectively fixed in the eyes *i* and *j.* The part of the axis between the barrels is made square, and is cut longitudinally to receive the lever *l,* which is secured in its place by a pin, but so as to allow of lateral motion between the two barrels; each of these barrels has a stud *m* and *n,* so placed that the lever may be shifted to engage either of them, and, consequently, to oblige that barrel with which it may be engaged to revolve together with the axis; *o* and *p* are two alternating irons, each with an eye at one end, through which a pin *q* passes in order to fasten them to the mangle-box; their height above the box is such as to allow them just to clear the axis when passing under it, and the motion of each is limited, but on opposite sides by the adjusting pins *r r.*

The figure represents the lever *l* as engaged with the stud *n,* and, consequently, as fixing the barrel *e*; now if the handle is turned so as to wind up the cord *h,* the cord *g* will proportionally unwind, and the mangle-box will move from left to right, till the end *l* of the lever comes in contact with the alternating iron at the point *o.* By continuing to turn the handle, the end of the lever slides from *o* to the end of the iron, and is brought into the position shown by the dotted lines; the stud *n* is consequently disengaged, and the barrel *e* becomes loose, at the same time the lever engages the stud *m*, and fixes the barrel *f*. The handle being still turned in the same direction as at first, begins to wind up the cord *i*, and thus makes the box begin to move from right to left, the cord *j* at the same time unwinding proportionally. When the left hand alternating iron has begun to come under the axle, the end of the lever will touch it at *p*, will slide along it to the point of the angle, and in so doing will bring it to the position shown in the figure, the barrel *e* being now fixed, and the barrel *f* being loose. Thus is accomplished the production of an alternating motion of the box, by continuing to turn the handle always in the same direction.

The back of the lever *l* is bevelled off, so that if the handle is turned in a wrong direction, it passes between the studs *m* and *n*, and not engaging either barrel, produces no motion of the mangle-box.

Fig. 2, one of the barrels separate.

Fig. 3, the square middle part of the axis, showing the slit in which the lever traverses.

XXX.—*On the different Black Colours. By the late celebrated* William Lewis, *M.B., and F.R.S.*

(Continued from page 192.)

IV. *Method of Dyeing Cloth Grey.*—The simple greys which are all no other than shades of black, are dyed nearly in the same manner as the full blacks, only by using a less proportion of the dyeing ingredients, or of continuing the cloth in the liquors for a shorter time.

A decoction of galls and solution of vitriol being prepared separately, a little of each of them may be put together at once into a copper of water made scalding hot: the liquor becomes black, and cloth dipped and worked in it, acquires a lighter or deeper grey according to the quantity of decoction and solution employed. By adding more of the liquors with the next parcel of cloth, and thus proceeding successively, a series of shades may be obtained, from the lightest to the darkest grey. Or the cloth may be first boiled with a proper quantity of galls and worked in the same liquor, with the addition of more and more vitriol, according to the intended depth of colour. The liquor remaining after the dyeing of full black, may be used also for the dyeing of greys.

For the quantities of the ingredients and the time of the cloth's continuance in the liquor, no general rule can be given, as they must depend upon the degree of colour required, the eye only can be the judge. If the colour happens to be too deep, it may be remedied in some measure by passing the cloth through hot water, mixed with a little decoction of galls, by which a part of the colour will be carried off. A weak solution of alum, tartar, or soap, are in this intention much more effectual, but at the same time very liable, particularly the two first, to exceed in their operation, discharging so much of the colour, unless due care is taken, as to occasion a necessity for re-dyeing the cloth, which is thus needlessly weakened by the repeated action of the corrosive liquor. The too great deepness of colour may be easily prevented, by examining the cloth from time to time, and taking it out as soon as it has acquired the due shade. It should be immediately washed with a large quantity of water, and the very dark shades should be scowered with soap, in the same manner as the full blacks, to fetch out the superfluous colour, or such as is not fixed in the cloth.

The simple greys are dyed from white cloth, without any previous ground of blue or other colours. There are also a multitude of compound greys or browns produced from cloth dyed blue, red, yellow, brown, or of colours compounded of these, by darkening them with the black dye. The distinctions of these various shades, and the manner of hitting any particular one, practice only can teach.

V. *The Dyeing of Wool Black.*—The natural grease of wool, of great advantage to it in the warehouse, as being a sure preservation against the moth, must necessarily be removed before it is attempted to be dyed of any kind of colour; the more perfectly it is cleansed, the better it will be disposed to receive the dye.

The liquor commonly used for the scouring of fleece wool, is said to be a mixture of stale urine, with twice its quantity of water. This mixture being made scalding hot, but not boiling, for a boiling heat would felt the wool, or make it run into lumps, so much wool as the copper will conveniently receive, is dipped in it, and turned from time to time with wooden poles, for a quarter of an hour or more; it is then carried in a large basket into running water, where it is worked by two men, backwards and forwards, one drawing it from under the other's pole, till it ceases to render the water turbid. The volatile alcaline salt (ammonia), produced in urine by putrifaction, unites with the greasy matter into a soapy compound, which, dissolving imperfectly in water, continues to give the turbid appearance to the water, till it is totally washed out. The wool is said to lose in this process between one-fifth and one-fourth of its weight.

The wool, thus cleansed, is dyed blue, then simmered with galls, and the black dye finished with logwood and vitriol; or, for a finer black, which, however, is seldom wanted on wool, the above method with verdegris may be followed. The manner of procedure is in all respects the same with that for dyeing woollen cloth; and all the observations, mentioned under the foregoing articles, are equally applicable here. It is only to be added, that the operations which wool has to undergo, render the preventing of harshness of more importance here than on cloth.

VI. *Black Dye without Galls.*—Of the galls directed in the foregoing processes, a part is commonly omitted in business, and supplied by cheaper ingredients, which, being weaker in virtue, are taken in quantities proportionably larger. From the high price of galls, I was induced to try whether this expensive article could not be entirely superseded. I proceeded exactly according with the French practice with verdegris, page 190, only, instead of the galls, taking six times as much oak-bark, such as the tanners use; the cloth, well washed with soap after the dye, appeared of a black colour, not indeed quite so beautiful as that dyed in the same manner with galls, yet not a bad one. I tried sumach also with the same event. It appears, therefore, that though no effectual substitute to galls could be found for the purposes of making ink, yet cheaper substances may often be made to suffice in the dyeing business, where the great consumption of astringent materials renders the reduction of the price of more importance.

In the Swedish Transactions, for the year 1753, a fine black is said to be dyed without galls or logwood; the place of both which is supplied by a plant, common in Sweden, called there *mjælon, or mjælon-ris,* which is gathered in autumn, while the leaves continue green, and carefully dried, that they may retain their green colour. A hundred pounds of woollen cloth are directed to be boiled with sixteen pounds of green vitriol, and eight pounds of white tartar, for two hours; and the cloth next day to be rinsed out, as after the common alum boiling. A hundred and fifty pounds of the dried *mjælon* cut a little, or a somewhat greater quantity, if the plant has been long kept, are boiled in water for two hours; and the *mjælon* being then taken out, a little madder is put into the liquor. The cloth is put in along with the madder, boiled for an hour and a half, or an hour and three quarters, and afterwards rinsed in water. This dye is said to be used chiefly for fine cloth, and to give less harshness than the common black.

What the *mjælon* is, we learn from a paper by Linnæus in the same Transactions, for the year 1743. He observes, that about a year before, a leaf, called *jackashapuck,* was brought into England from North America, and mixed with tobacco for smoking. Mr. P. Collinson favoured him with large specimens of it, entitled "the plant jackashapuck, which is mixed with tobacco, gathered on Churchill river, in Hudson's bay." This plant, he says, was easily known by a Swede, as it grows on uncultivated, gravelly, sandy hills. He gives it its Swedish names, *mjælon, mjælon-ris, mjælbars-ris;* and likewise the Latin names under which it is described by different botanic writers, from which it is clear, that the *mjælon* is the same with the *uva ursi* that has come into esteem in Germany for medicinal use. Some quantity of the *uva ursi* has been brought from Germany to be tried as a medicine in this country: the plant is raised also in some of our botanic gardens, and if the propagation of it should be found of any importance, it would doubtless thrive on many of our now barren hills.

I have been informed by a foreign correspondent, that the *uva ursi* is said to be used in England for dyeing black, and that it is imported for this purpose from Hudson's bay. I cannot find that this plant, or any other from Hudson's bay, is known among our dyers or dry-salters; but the two foregoing quotations account sufficiently for the report.

I made trial of the German *uva ursi* both on white and on blue cloth, exactly according to the Swedish directions; boiling the cloth first with vitriol and tartar, and afterwards with a decoction of the *uva ursi*; on the blue cloth I obtained a tolerably good black, but on the white cloth, as with other astringents, the colour was only a dark brown. I repeated the experiment without the madder, and with a variation in the order of applying the other ingredients, boiling the cloth first in a decoction of the *uva ursi*, and then adding the vitriol and tartar; by this method I obtained, as before, a pretty good black on the blue cloth, but only a brown on the white. I afterwards omitted the tartar also, and I did not observe that the want of it occasioned any difference in the colour produced. All the samples dyed brown with the *uva ursi* and vitriol, became black on being passed through logwood liquor; but without either logwood or a blue ground, no true blackness could be obtained. A dyer whom I consulted on this head, made some trials for me, on the *uva ursi*, with the same event; this plant giving no black dye with vitriol alone, any more than the other astringents.

On adding green vitriol to a strong decoction of *uva ursi*, I took notice of a phenomenon which did not happen at all with galls, and which I do not remember to have observed in so remarkable a degree, with any of the other strong astringents. The liquor, instead of the uniform appearance of the common black mixtures of this kind, looked like a black powder diffused through water, and being written with on paper, the strokes appeared every where unequal and specky, as if made with charcoal-powder and water, though they were of a deep and durable black, where the colouring matter lay thick. This hasty concretion of the black matter from the liquor, while it renders the *uva ursi* entirely unfit for the purposes of making ink, may possibly be of some advantage to it for the black dye; as the largeness of the colouring particles which concrete in the pores of the cloth, may render them more fixed, so that less of the colouring matter is wasted in the liquor, and less of it can be discharged from the cloth. To this cause may perhaps be ascribed a quality of the *uva ursi* dye, mentioned by the Swedish author, that the cloth is cleaner than after the other black dyes, or requires less washing to free it from the loose colour.

Among many astringents I have tried, oak-wood came the nearest to the *uva ursi* in this concretion of the colouring matter. A piece of white flannel was boiled first with oak saw-dust, and afterwards with an addition of vitriol, as in the foregoing process. The liquor, as soon as the vitriol was put in, became blueish-black, though with much less blueness than the cold infusion of oak-dust and vitriol, I formerly had tried; some of it being poured off into a glass, it appeared full of a powdery matter, which soon settled to the bottom, leaving the liquor of a pale blueish colour. From the blue colour of this mixture, it was hoped that a black dye might be obtained from it, without logwood or a blue ground; and in effect, the piece of flannel, though it did not acquire a true black, approached more to blackness than I remember to have observed with other astringents; its colour was a dark grey, without any mixture of blue or brown, like a pure black diluted with a little white. This wood seems, therefore, to deserve the attention of the dyers; there are grounds to believe that oak saw-dust, or the heart of oak reduced to powder in mills, will be found an astringent of sufficient efficacy, and supply with advantage the place of galls: the oak-tree doubtless contains a matter similar to the galls which are produced from it. Possibly, by some preparation of the oak-dust, it might be brought nearer to the nature of galls; does not its difference from galls depend on some particular juice, more soluble than the direct astringent matter, and separable by slight infusion in cold water?

VII. *Black Dye, from a Combination of Colours.*—In the first article of this section it has been shown, that the madder dye, required by the French regulations to be applied upon blue cloth as a ground for black, is rather injurious to the colour, than of any real advantage. In the experiments which the determination of that point required, a somewhat unexpected phenomenon occured, an account of which was reserved for this place. A piece of deep blue cloth was boiled in water with alum and tartar, as customary, for preparing cloth to receive the madder dye. The cloth being taken out and squeezed a little, some powdered madder was boiled in water, in such a quantity as to communicate a dark red colour to the liquor. The cloth, still moist, was put into this decoction, and a boiling heat continued about half an hour. Being then taken out, and washed with soap, it looked of a very dark colour, such as any person would call a black, though not a very fine black. Thus we have a kind of black dye, very durable, without any vitriol or any other preparation of iron, from a combination of the blue dye with the madder red.

This effect of madder upon blue cloth is well known to the dyers, among whom the colour hence produced is called madder-black. Our black cloths for home consumption are all dyed with vitriol and astringents, either on a ground of woad, which makes the true black, or with an addition of logwood only, in which case the colour being more perishable is called false; but the black baizes, which we export to Spain and Portugal, are dyed chiefly of the madder-black, a species of blackness, which there, it seems, is in estimation.

If, instead of madder, the pure red of cochineal be applied on blue cloth, the colour hence resulting, is not at all black, but purple. Cochineal, independently of its too great expensiveness for purposes of this kind, is too bright a colour to have place in the composition of blackness; to change the purple into a colour approaching to black the addition of other colours is necessary, for it is not to be expected that a mixture of simple blue and red should produce a black. But madder is both a dark and a compound colour, in which an admixture of brown and tawny with the red is very manifest. If the madder be slightly infused in warm water, and afterwards boiled in a fresh quantity of water, the first liquor will appear of a pretty good red colour, the other remarkably more dark and brownish. Hence, for dyeing a good madder-red, a boiling heat should be avoided, but for the black dye the madder ought to be well boiled, that the brown as well as the red parts may be extracted.

The madder-black might probably be deepened by making it still more compounded, as particularly by the addition of a dark yellow; but any improvement of this kind would be of little advantage to the dyer, who, finding the dye already too expensive, endeavours to imitate it with the cheaper vitriolic black. And, indeed, independently of considerations of this kind, he is here rather confined to a particular shade or species of colour, which fashion has brought into esteem, than solicitous about deepening the dye, or making it more perfectly black.

Of the Dyeing of Silk Black.—Raw silk, in the state in which it is wound off from the cocoons, has a harshness which renders it unfit for being spun, and for the most part a pretty deep yellowish or reddish-yellow colour, from both which it is cleansed by boiling it with soap, and afterwards thoroughly washing it with soft water; when woven, it is again washed with soap, to free it from the greasiness it may have contracted, which would occasion it to be spotted in dyeing. The silk loses in the boiling generally about a fourth part of its weight; this proportion is assigned by the writers on dyeing, and on inquiry among the workmen, I find it universally allowed to be the nearest calculation. In being dyed black, this loss is fully made up, the weight of the dyed silk being commonly even greater than that of the raw silk. There is no dye which adds so much to the weight as black; the increase is considerable in woollen as well as in silk, though most taken notice of in the latter, on account of its great price.

M. Macquer observes, in "*Art de la Teinture en Soie,*" published in 1763, that the finest oil-soap is required for this cleansing of silk; that there is nothing saved by using the inferior kinds, a proportionably greater quantity of them being necessary; that some sorts of soap curdle with the matter which they extract from the silk, into a substance almost of the consistence of wax; that those which are made with animal fats, prevent the silk from having the proper dryness and lustre, and dispose it to grow reddish in keeping; that even the best soaps are accompanied with some imperfections in this respect, and that the superiority in lustre of the Chinese silks to the European, is owing to the former being cleansed without soap. In a French dissertation on this subject, to which a premium was adjudged by the academy of Lyons, in 1761, the ill qualities of soap are attributed to its oil; and a solution of simple alkaline salt, made so dilute as not to corrode the silk itself, is recommended in its place: the salt of soda or barilla, as being the mildest of the alkaline salts, is for this purpose justly preferred to the common more corrosive alcalies. Alkaline salts, either in their pure state, or made into soap with oils, are the only known menstrua that extract the matter which gives harshness and colour to raw silk.

What this matter is, has not been sufficiently examined. As it is not dissolved by water, spirit of wine, or by acids so far diluted as not to destroy the silk itself, M. Macquer supposes it to be either a concrete oily substance, whose oil is of the nature of expressed oils, or a compound of gummy and oily matter, so proportioned and combined, as to protect one another from the action of their respective solvents. Whatever can be said of the composition of this matter, may perhaps be said equally of that of the silk itself, which is not an organised fibre like wool, but is in its whole substance a concrete animal juice; naturalists observe, that on opening the silk-worm at a proper season, the yellow silky juice may be readily distinguished, and drawn out into fine flexible filaments. Alkaline salts, which, when diluted with water, or sheathed in oil, to a certain degree, are found the proper menstrua of the harsh and tinging part of raw silk; in a purer or less dilute state, or by longer boiling, dissolve also the matter on which the tenacity or cohesion of the silk depends. Some of the spun silk, called in the shops raw silk, but which has been boiled with soap previous to the spinning, and suffered the diminution of weight before-mentioned, on being boiled in a solution of alkaline salt, received a further diminution of two-thirds; another quantity of the same silk being boiled longer with the alkali, about four-fifths of its weight were taken up by the liquor, which became reddish, and the remaining fifth was an incoherent friable mass, not ill resembling *papier maché.* It should seem, from these experiments, that even the common process of cleansing silk, in which a fourth of its weight is dissolved, cannot be entirely innocent, but must contribute in some degree to diminish the strength of the silk; and accordingly I find it allowed by the workmen, that a thread of silk boiled is not so strong as when raw.

Silk is rarely or never dyed of a blue as a preparatory ground for the black dye. The regulations of the French silk dyers expressly order its being directly dyed from white to black, and this, as I am informed, is the general practice among us, though some report that the German silk dyers give a brown ground to their black silks, by boiling them with the root or bark of the walnut-tree. The only reason I have heard assigned for the omission of the blue ground on silk, is its adding to the expense of a process which is otherwise more expensive and troublesome than the dyeing of woollen.

M. Macquer reckons black a difficult colour to dye on silk; and, indeed, if all the circumstances and materials of the complex process, which he describes as being followed in many of the dye-houses in France, were necessary for succeeding in the colour, a multitude of trials must undoubtedly have been made before success could have been obtained. But experience has abundantly shown that the case is otherwise; that the fenugreek seed, fleawort seed, cummin seed, coloquintida, cocculus indus, blackthorn berries, agaric, nitre, sal-ammoniac, sal-gem, litharge, antimony, black lead, orpiment, corrosive sublimate, white arsenic, and realgar, several of which are added again and again in different parts of the operation, are entirely inessential to the dye, and contribute rather to do harm than good. M. Macquer himself suspects that some of these ingredients are unnecessary; and he has subjoined a process followed in the manufactories of Tours and Gênes, from which we may fairly conclude that they are all so; and that a fine black may be dyed on silk in as simple a method as on wool or woollen cloth, the silk requiring only a greater quantity of the ingredients, and a greater number of dippings in the black liquor. The process is as follows:

The silk, washed with soap as above directed, is steeped in a decoction of one-third its weight of the weaker white galls of Sicily and Romania, and afterwards washed with water; every twelve ounces are reduced by cleansing to nine, which ought to be increased by the galling to eleven, and not more. The dyeing liquor for a hundred pounds of silk, is prepared by boiling twenty pounds of galls in a sufficient quantity of water (about a hundred and twenty-six gallons), and adding to this decoction, after being settled and drawn off from the sediment, two pounds and a half of English vitriol, twelve pounds of iron-filings, and twenty pounds of the gum of the plum or cherry-tree; that the gum may dissolve the more readily, it is put into a large copper colander, immersed in the hot liquor, and stirred and worked from time to time, with a wooden rod, till it has all passed through the colander. This mixture is kept for six or seven days or more, a circumstance supposed to be necessary to its perfection; and being then made as hot as the hand can bear, fresh parcels of the galled silk are dipped in it successively, and kept in about ten minutes each; and all of them, after being aired, are dipped over again several times, with the addition of more vitriol and iron-filings, till they have acquired the requisite blackness, after which they are well washed in water. It may be observed, that while five or six pounds of galls are sufficient for a hundred pounds of wool, upwards of fifty pounds of galls are here allowed to the same quantity of silk; and that logwood, an essential ingredient in the black dye on white woollen, is not at all required for silk. The quantity of vitriol is not specified.

I tried this process in small, with the exact proportion of each of the articles above set down; and by adding more and more of the vitriol, I obtained at last a good black. After less than half this number of dippings, the silk appeared of a beautiful black when taken out of the liquor, but by washing it became pale, and in drying, it always turned paler. The quantity of vitriol used in all was about eight times that prescribed above to be added at one time, or one fifth of the weight of the silk; but the iron-filings put in at first remaining undissolved, it was not thought needful to add any more of this ingredient. I repeated the operation without any iron-filings, and could not observe that the two blacks differed from one another. I tried also without the gum: there was here a very considerable difference in the silk, as taken out of the dye; that which had been dyed with gum, having a fine glossiness, which the other wanted; the subsequent washing, however, destroyed, as was expected, the glossiness of the gummed silk, and reduced them both to the same appearance, so that the gum seemed to be of no manner of advantage; perhaps it is rather of disservice than otherwise, by thickening the liquor, and making it more difficult to penetrate into the silk, in the same manner as it renders ink indisposed to sink into paper. I likewise dyed some silk by the two processes described in the foregoing section for woollen cloth, and obtained, by both of them, a rusty black upon white silk, and a very good black upon blue; so deep a blue as is allowed for the true black on fine woollen cloth, did not appear necessary for silk; a very slight blue ground being here sufficient to make the black both deep and durable.

It should seem, therefore, that silk is not, in any particular manner, more averse than wool to the receiving of the black dye; and that a good black may be dyed on silk with the same materials, in the same method, and with the same dispatch, as on wool and woollen cloth; of which a further confirmation will appear at the end of the following section. It may be observed, that though silk takes a sufficiently good black dye from the method practised for fine woollen; yet woollen does not take a black from the process that has been appropriated to silk; for some pieces of white flannel having been put in along with the white silk, in one of the trials of the French process above described, the flannels became only brown, while the silk turned out black. Though a black may be dyed on white silk without logwood or verdegris, the first of which is a necessary material for white woollen; yet an addition of both contributes not a little to improve the colour on one, as well on the other.

(To be continued.)

XXXI.—*On an improved Log-ship. Invented by Mr.* JAMES HOOKEY, *R.N.**

WITH FIGURES.

SIR, *Royal Dockyard, Deptford, February, 16, 1827.*

I SHALL feel particularly obliged by your laying before the Society of Arts, &c. a log-ship invented by my son, James Hookey, Admiralty midshipman on board his majesty's ship Barham, recently sailed for the West Indies, with an improvement in the log and lead lines.

The advantages gained by this invention are, that it gives the distance the ship runs more correctly, as it remains more stationary in the water than the one now in use; and when required to be hauled into the ship, by giving it a sudden jerk, the toggle swivels round, and disengages the line from the spring, in consequence of which, the log-ship reverses its position, and may then be pulled into the ship with the greatest ease.

With respect to the lines, he recommends that they be saturated in a composition of oil, which makes them more buoyant and pliable, and prevents kinking; it likewise prevents their contracting, which in new line is about twenty feet in fifty fathoms.

As many serious accidents are likely to occur by getting a false depth of water, in consequence of the contraction of the line attached to the lead, it becomes an object worthy of attention to prevent the possibility of such accidents taking place.

I am, sir, &c. &c. &c.

A. AIKIN, *Esq., Secretary &c. &c.* W. HOOKEY.

CERTIFICATES.

(Copy.)

HONOURABLE SIRS, *Deptford-yard, January, 17, 1827.*

Agreeably to the directions in your letter of the 15th instant, to give my opinion on the model of a log-ship invented by Mr. James Hookey, mate of his majesty's ship Prince Regent, I have this day tried it in the river, by rowing a boat against the tide, and am of opinion it is in every respect the most complete invention for a log-ship I have ever seen, and trips with the greatest ease, either with a long or a short length of line being veered out. And I would humbly beg to recommend that models of it be made at this yard, to be sent to all the other yards, to be supplied to all ships and vessels when commissioned, as in the event of one being carried away, the carpenters of the ships might make them, so as always to have a spare one.

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* From vol. XLV of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce. The society voted its large silver medal to Mr. Hookey.

Honourable Navy Board. J. DOUGLAS.

These are to certify that I tried a log-ship, invented by Mr. James Hookey, Admiralty midshipman, on board the Supply, naval transport, during a voyage from the river Thames to Leith and back, and found it answer extremely well; it gave the distance very correctly, by remaining more stationary than the old log, and when required to be pulled back to the ship, it disengaged itself with the greatest ease. I therefore recommend it to be used in preference to the old log, as I consider it very far superior.

Given under my hand, on board the Supply, naval transport, at Deptford, this 1st day of February, 1827.

H. I. K. WALKER, *Master*.

Instructions for using the Log-ship invented by Mr. James Hookey, of the Royal Navy.

The eye in the line is to be put over the toggle, on the tail of the fish, and when the line is all run out from the reel, and it becomes taught, by giving it a sudden jerk, the toggle will swivel round; the fish will then reverse its position, float on the surface of the water, and may be hauled into the ship with the greatest ease. When it is necessary to shift the line at the head of the fish, knock out the peg that forms the eye, and the line will then disengage itself; and in attaching another line, make an eye in it, and pass it into the mouth of the fish perpendicularly, through which put the peg that forms the eye, and it will be quite secure.

The inventor strongly recommends that all log-lines and lines to the lead should be saturated for one hour in linseed and lamp oil, three-fourths of the former, and one-fourth of the latter, well mixed together; after which, hang them up to dry; contraction will thereby be prevented, which in all new lines is twenty feet in fifty fathoms; besides, by thus saturating them in oil before they are used, they become more buoyant and pliable, and are prevented from kinking.

N. B.—The spring to the toggle may be fixed either on the upper or the lower side of the fish.

Reference to the Engraving.—Plate V.

The log is formed like a fish. Fig. 4 represents one running out, and fig 5 the same in the act of being pulled in; *r* the toggle, *s* the spring; the eye of the line is put on the toggle, which is then pushed under the spring; the flap-board *t* falls down, and the fish runs out. When the line is taught, a sudden jerk will make the toggle pass the spring, and let go the line; the fish then swings round, the flap-board *t* closes, and it is easily pulled in.

Fig. 6 shows the under side; the flap-board *t* is jointed to the fish by the strap of copper *v*, which passes round a pin *u u*, and this pin is held by the copper-strap *w;* the line is attached to the log by a loop which goes in at the mouth, and is held by a peg which forms the eye; the flap-board *t*, if made of copper, has a piece of wood rivetted to it in the middle to stiffen it; if made of wood, a slip of lead or copper *x* is rivetted on, to make it heavy enough to drop down readily when thrown in the water.

Fig. 7. A top view of one made thin and wide like a flat-fish; the spring which holds the toggle is underneath, between the fish and the flap-board *t;* the spring may be above or below in either case.

XXXII.—*On the Manufacture of Marbles in Germany*[*].

THESE well known articles are made in great quantities to serve in the games of children; some are formed of potter's clay, covered with a glaze and burnt in a proper furnace; others are made of marble and alabaster, but chiefly of a species of very hard calcareous stone, found in the neighbourhood of Cobourg, in Saxony. These stones are first broken into square blocks by means of a hammer, and are finally rounded into spheres or small balls by a mill. In order to this they are placed from one hundred to a hundred and fifty at a time, upon a fixed slab of stone, having a number of concentric circular grooves or furrows made in its flat surface. Above this stone another flat slab or block of oak, of the same diameter, is supported by means of a lever, and turned round by the power of the mill. During the rotary action of this mill, small threads of water are made to enter each of the concentric grooves, which favour the rounding and polishing of the balls, and prevent the wood from heating. The operation for each of the quantities above mentioned, lasts for a quarter of an hour, and the balls or marbles become perfectly spherical and fit for sale. Immense quantities of them are exported to India and China. A mill with three turning blocks will manufacture 60,000 marbles a week.

XXXIII.—*On an improved Cap for a Malt-Kiln, invented by Mr.* WILLIAM HENRY PERKINS[†].

WITH FIGURES.

SIR, *Stanstead, Herts, November* 1, 1826.

HAVING made a considerable improvement in malt-kilns, by substituting a cap, in place of the usual cowls, I shall be glad to obtain the approbation of the Society of Arts, and will attend with a complete model thereof, on being favoured with notice when the subject will be taken into consideration.

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[*] From the *Archives des décour. et invent.* 1826; and republished in Ferussac's *Bulletin des Sciences Technologiques*, January, 1828.

[†] From vol. XLV of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce. The society voted its large silver medal to Mr. Perkins.

I am, sir, &c. &c. &c.

A. Aikin, *Esq. Secretary, &c. &c.* Wm. Henry Perkins.

The common cowl of a malt-kiln is a long, somewhat conical, cap, open at one side, and having the vane or arm so fixed, that, as the wind shifts, the cowl shall turn on its spindle, and always present the boarded or closed side to the weather. This prevents drifted rain from beating in; but in showers, when the wind is still, the wet readily finds its way in: this, if the floor is loaded with malt, retards the drying of it, and, if empty, rusts the iron wire of which the floor is composed, except it is covered with sacks, straw, &c.

Another inconvenience attending the common cowl is, that it prevents all accurate regulation of the fire, except by varying the supply of fuel; so that in making the high-dried malt, it is by no means uncommon for the grain on the kiln to take fire, to its own certain injury, and the imminent hazard of the premises. Mr. Perkins's cap, by enabling the chimney to be opened, or, if necessary, entirely closed, offers additional security against these accidents.

Fèlix Booth, Esq. of Brentford, in a letter dated 1st May, 1827, reports to the secretary of the society, that he has made trial of Mr. Perkin's cap for the last three months. He has found that a saving in fuel has resulted from its use, and that the malt has been benefitted by the facility which the invention affords of regulating and varying the heat according to the increasing dryness of the malt, and other circumstances.

Reference to the Figures.—Plate V.

Fig. 8 represents the turn-cap *a a a*, and neck *b b* in section; *c c* a square iron bar, or spindle, sliding through a square hole in the middle of the iron plate or bar *d*, and through another in the middle of the beam *e*: the cap *a a* turns upon the upper cylindrical portion of this bar, and the bar itself is supported and hangs entirely on the chain *f*, attached to the pully *g*, which is mounted in a carriage on the beam *e*; on the same axis is a larger pully *h*, with a chain attached to it at *i*, and from which a weight *j* hangs, sufficient to balance the weight of the sliding-bar *c*, and turn-cap *a a*. By raising the weight *j* the cap is lowered, and finally shut, and on lowering the weight the cap is raised quite up, or held at any intermediate height.

Fig. 9 is a section of the neck between the bars *d* and *e*.

Fig. 10 a top view of the bar *d*, showing the hole through which the spindle passes; *k*, fig. 8, is a similar iron bar across the cap *a a*.

The chain *f* should be attached quite close to the bar *c c*, to lessen its tendency to lean on one side.

XXXIV.—*On the Manufacture of Iron and Steel in India*[*].

Of the Iron One.—"At Ghettipura I not only found the ore in several places, but also the pits from which the people were then actually taking it to supply their furnaces. I am at a loss for the desire of concealment relative to minerals amongst the natives, which also extends to every kind of quarry throughout the country, and which equally pervades the officers of government and the other inhabitants. Men who have given me apparently correct information relative to their farms, have eagerly denied a knowledge of the fossil kingdom, which they no doubt possessed, and for which denial I can assign no plausible motive. The late sultan (Tippoo Saib), indeed, is said to have harassed his subjects exceedingly, by making them work at quarries, and also to have been very severe on the smelters of iron; and the people may have suspected that my inquiries might lead to similar oppressions; but according to the iron-smelters' own account, the sultan gave them a high price for their iron, and by his great demand afforded them constant employment. It is probable, however, that he compelled them to work much harder than they were inclined to do, and that they were defrauded by those who were entrusted with the payment.

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[*] From "A Journey from Madras, through the Countries of Mysore, Canara, and Malabar." By Francis Buchanan, M.D. 1807. Dr. Buchanan was deputed by the Governor General to inquire into the Mines, Manufactures, Agriculture, &c. of these territories; and we are assured by a gentleman well acquainted with them, that his information may be relied upon for its accuracy.

"Much steel was formerly made at Ghettipura, from whence it derives its name, which signifies, literally, *hard town*. It is a small village, near Sevendroog. Near it are many cultivated fields, intermixed with low rocky hills. The ore is found both in the fields and hills.

"The iron ore of the fields consists of small irregular masses, separated by thin layers of earthy matter, and is found in beds, that are from five to ten feet deep, which have only been wrought in a few places, when they come so near to the surface, that they have been discovered by the plough. It is probable, that by digging deep, they might be found to be of great extent. The small masses are easily beaten into powder, and then the black sand is readily separated, by washing, from the clay and sand that are the other ingredients in their composition. This ore is of two kinds; one efflorescing into red ochre, the other into yellow. Intermixed with both these kinds of ore, which are called female stones, are many lumps of what the natives call male stones. It appears to me to be composed of the same materials with the female stone, but is so hard, that the imperfect manipulations of the natives cannot reduce it to a powder, and of course they cannot separate the earthy matter. It is therefore looked upon as useless, fluxes being entirely unknown to the miners of Mysore. The female stone appears to me to be male in a state of decay.

"The iron ore of the hills is also male and female, the latter being the only one used; and this is also, in my opinion, the male in a state of dissolution (decomposition). The male stone in the hills bears a much larger proportion to the female, than it does in the fields. This ore is also found in digging a very little depth into the soil, and seems to be the source from whence most of the black sand of the country is washed by the rain."

"The female stone is very easily reduced to powder, and the iron-sand is readily separated, by washing, from the quartzose-sand, which is the other ingredient in the ore. It is not so rich in metal as the ores found in the fields. These two ores are called *Aduru Cullu*, or stones containing iron-sand.

"On the surface of the hills is found another iron-ore, called *Ipanada*, which is scattered among the gravel in small lumps, from the size of an egg downwards. They are a pure ore, and are put in the furnace without any preparation, except breaking the larger pieces into bits about the size of a filbert. The quantity of *Ipanada* required for one furnace is exactly the same, by measure, as that of *Adura*; but the weight of *Ipanada* is of course less, there being more space occupied by interstices, from the greater size of the pieces. The produce in iron from both is the same. The surface of the lumps of Ipanada is often covered with a kind of black enamel."

"During the four months of heavy rains, four men are also able to collect as much sand in the channels of the torrents, as a furnace can smelt in the remainder of the year. In order to separate the earth and sand from the ore, it requires to be washed. These men get ten *harams*, or six shillings and eight pence half-penny, a month, and the nature of their service is similar to that of the farmer's servants, being bound by occasional advances of money to continue in the employment of their master. During the remaining eigth months of the year they work at the forge.

"The smelting furnace is made in the front of a square mound of clay, sloping up gradually from behind forwards*. In the front the mound is twenty-two inches high, and three feet broad. In this mound, from top to bottom, is made a semi-cylindrical cavity, about a foot in diameter. On the ground, in front of the cavity, is laid a square hearthstone, six inches thick, a foot long, and a foot broad. Contiguous to this is placed another stone upright, a foot square, and two inches thick. On the top of this last stone is fixed a small piece of timber, having a hole in it, through which the nozzles of the bellows pass, and behind which rises another mound of clay, sloping upwards gradually, and widening as it recedes from the furnace; on this mound rest the two pairs of bellows. Each pair of bellows consists of a whole buffalo's hide, removed from the carcase of the animal without cutting it lengthwise. Where it has been cut at the neck, it is sewn up, so as to leave a small opening for a wooden nozzle, which is made fast to the piece of timber before-mentioned. The hinder part of the skin is slit vertically, and the one side or flap is made to lie over the other, two slips of bamboo-cane being stitched, one to each flap, to open or close them by. In the middle of the outer end of the bellows is fastened a ring of leather, through which the workman passes his arm, and seizes the ends of the bamboo slips, which serve as handles. When he draws back his arm he suffers the slips to extend, and the opening in the hinder part of the skin is dilated, and admits the air; when he forces his arm forwards and downwards, the opening is closed up, and the air is forced forwards through the nozzle of the bellows. The lower part of the bellows is retained in its place by a rope fastened to its lower angle, and supported by an elastic piece of timber, which is fastened to one of the posts of the hut, like the pole of a turner's lathe. The nozzles of both the bellows are inserted in one common tube, which is made of baked clay, and is placed in a sloping direction, so as to pass through a mass of moist clay, that occupies the front of the furnace above the first-mentioned stone or hearth. Above this is placed a large tile; and the empty spaces between this and the first-mentioned mound are filled up with moist clay. The furnace is now made cylindrical, and open at top, on which is placed a chimney, made of baked clay, in the form of two truncated cones joined together by the apices. Of these, the upper cone, or hopper-shaped mouth, is by far the shortest. From this description, it must be perceived that the whole lower front of the furnace is moveable, and when it has been newly built up, a little charcoal is burned in it for an hour, to dry the moist clay by which the various parts are connected. The rents formed during this operation must be carefully closed with more clay, and the furnace is then ready for immediate use.

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* Figures of this and other furnaces will be given in the sequel of this article. Editor.

"For smelting the black sand, the following is the process. A quantity of the sand is measured out, and divided into three parts, each of which I found to weigh a little more than twenty-five pounds eleven ounces avoirdupois. Three baskets of charcoal are then set aside, of which each contains about a bushel. Two of the baskets of charcoal are then put into the furnace at the top of its chimney, and above these one-third part of the sand. The fire is then kindled, and urged with the bellows. When the fire subsides, one half of the remaining charcoal, and another third of the sand are put in; and when these have again subsided, the remainder of the sand and charcoal is added, and the fire is urged six hours and a half from the commencement. The front of the furnace is then broken, and on removing the walls, a mass of iron is found at the bottom, which is taken out with tongs, and cut into blocks, each weighing half a maund, or a little more than twelve pounds two ounces. By this it would appear that the ore produces no more than about thirty-one and a half per cent.; and the iron so produced, although malleable at first, is exceedingly impure. Tippoo took it from the workmen at three fanams a maund, or nine shillings and three pence halfpenny a hundred weight. He gave them, however, great employment, as he made his shot of this iron, by hammering, for the fusion is never so complete as to allow it to be cast in moulds.

"In order to render this iron more pure, and to fit it for being wrought up into the implements of husbandry, it is taken to another house, and repeatedly forged. There are here also two pairs of bellows, but they are smaller than those in the smelting-house; and the mound on which they are supported being low, a pit is formed behind it, in which the labourers stand, in order to place them on a proper level for their work. The nozzles of the bellows are inserted into an earthen tube, which conveys the air into the furnace through one of its side walls. These walls are two masses of clay, one cubit long, ten inches high, and four inches thick; and are placed on the floor, parallel to each other, at the distance of a foot. On them is laid a flat cover made of baked clay, and about an inch and a half in thickness. In its hinder part is an oblong opening, sufficient to admit one of the blocks of iron. The fore part of the furnace is secured on the top by a moulding of clay, which is somewhat ornamented. Before it is placed a stone, a cubit long, twelve inches broad, and three high. Except what is shut up by this stone, all the fore part of the furnace is open. The hinder part is entirely shut up with clay, except a small opening, by which the ashes and vitrified scoriæ fall into the ash-pit.

"A block of iron from the smelting-house having been put into the centre of the furnace, it is filled with bamboo charcoal, and strongly heated; while another block is put into the upper opening, to receive some heat as a preparation. When the first block is properly heated, it is placed on an anvil, and receives a few strokes of large hammers from three workmen, who stand in three sunk cavities, formed around the anvil, to reduce them to a proper level, and who thus knock off some ill smelted portion of it, and much of the adhering scoriæ. With a kind of hatchet (chisel) the block is then cut into three wedges, and in this operation the workmen show much dexterity. The second piece is then put into the centre of the furnace, and a third piece is placed in the upper opening of the furnace; while these are heating, the three wedges are again made red hot, and well beaten on an anvil by the three workmen with large hammers. In this state the six wedges produced from one smelting weigh twenty-four seers, or a little more than fourteen pounds and a half avoirdupois, and are sold to the blacksmiths, who are, however, obliged to heat and beat the iron three or four times before it is fit for making the implements of husbandry. The weight of the six wedges is then reduced to fifteen seers, or a little more than nine pounds; and they sell it at from two to three fanams, or from about one shilling and four pence to two shillings; that is, from about sixteen shillings and six pence to twenty-four shillings and nine pence a hundred weight. From this it appears, that the good malleable iron, produced by this means, is not quite 12 per cent. of the weight of the ore.

"The same persons also make steel *(wootz)*. Good fire-clay is mixed with an equal quantity of the charcoal that is made from paddy husks, and having been well moistened with water, is thoroughly mixed by being trodden under the feet of oxen. It is then picked clean, and made into skittle-shaped melting-pots, which are dried one day in the shade, and next day in the sun. A fire-place is then made, in the form of a parallelogram, by placing two stones, one cubit long, and two inches and a half high, parallel to each other. At the distance of a foot above the stones is placed a wall of clay, eight inches high. One end is shut up, in the same manner, by stone and clay; the other is built up with clay alone to the height of two cubits. Through this end is inserted a tube for two pairs of bellows. Each of the melting-pots is now charged with a small piece of iron, from one to one and a half seer (nine and seventenths ounces to fourteen ounces) in weight, together with five small pieces of the Tangayree wood *(cassia auriculata)*, and its mouth carefully covered and luted with clay. Three rows of the filled melting-pots are placed one above the other in the form of arches, so as to occupy the whole space of the furnace; the room of one melting-pot only being left empty, opposite to the nozzles of the bellows, in order to give access to the wind. They are covered with two bushels of charcoal, and burned for six hours; a third bushel of charcoal having been added as the former two were consumed. The pieces of steel are then taken out, and hammered into small square bars, having been heated with charcoal of the sujala *(Mimosa Tuggula, Buch.* M.S.S.)

"The expense that attends the working of one of these iron forges, is as follows:—

	fanams
"To four men for collecting iron-sand, or ore, at ten fanams each, for four months	160
"To six men to make charcoal, four for the smelting-house, and two for the forge, during eight months, at eight fanams monthly for each	384
"To four labourers at the smelting-house, for eight months, at ten fanams each	320
"To six labourers in the forging-house, of whom one has twelve fanams, the others six fanams a month, for eight months . .	336
"To the government paid yearly, for making charcoal, sixty fanams; for ground rent for furnace, twenty fanams; for ditto for servants' houses, twenty fanams	100
Total . .	1300

"The smelting-house burns twice a day, for about eight months at thirty-two days each, without any allowance for holidays; and at each time produces as much iron as, when forged, sells at from two to three fanams.

	fanams.
"At two fanams, the returns are	1536
Cost	1300
Net profit . .	236

	fanams.
"At three fanams, gross produce	2304
Cost	1300
Net profit . .	1004

"The operation for smelting the ore is exactly the same as that used for the black sand, except in the clearing of it: The ore is first reduced to powder with an iron bar (a pestle,) and then the earthy particles are washed away in a wooden trough; when it becomes exactly like the black sand, and is called by the same name, *aduru*. The collecting of it is attended with less trouble than that employed to collect the black sand; but the carriage to any considerable distance prevents it from being used in general; as the workmen must live where the farmers can give them employment in their vacant time.

"Two other men, one from *Ghettipura*, and one from *Cutlu*, on the way to *Bangaluru*, confirm the above account. Each smelting, according to them, takes nearly sixty-eight pounds of black sand. The difference here, from the other account, probably arises from my having weighed the former when very moist, and this when dry: for the workmen always put the sand into the furnace, after having thoroughly soaked it with water. According to this account, however, the ore gives rather more than thirty-seven per cent. of the impure iron, and a little less than twenty per cent. of iron fit for the use of the blacksmith. For this purpose, after it has been cut into wedges, it requires to be four times heated and hammered.

"According to the account of these people, the following are the expences of a smelting-house and forge:—

	fanams.
"To three men to collect and prepare the ore for nine months, at ten fanams	270
"To five persons to make charcoal, at ditto	450
"To the head workman at the smelting-furnace, at fifteen fanams a month	135
"To three under workmen at ditto, at thirteen fanams each a month	351
"To the head workman at the forge, at twenty fanams a month	180
"To three hammer-men at ditto, at nine fanams each	243
"To two bellows-men at ditto, at eight fanams each	144
"Paid to the government:—	
"For liberty to make charcoal	200
"For ground-rent of furnace	10
"Ditto for workmen's huts	54
"Total of expences	2037

	fanams.
"Produce of the three smeltings daily for nine months, of 32 days	1728
"Loss	309
"Gross produce, at three fanams each smelting	2592
"Total expence	2037
"Profit	565

"In this account the expences greatly exceed those stated by the first man, and seem to me to be much exaggerated. The persons who gave it allege that the Ghettipura ore has not been lately wrought."

(*To be continued.*)

XXXV.—*On the Manufacture of Iron Wire, for the strings of Musical Instruments, in India.* By FRANCIS BUCHANAN, *M.D*[*].

"ANOTHER manufacture for which Chinapatam is celebrated, is that of steel wire[†] for the strings of musical instruments, which is in great esteem, and is sent to remote parts of India. A very distinct account of this manufacture was given me by Colonel Close, who procured it from Mr. Ingledew, surgeon to the resident in Mysore. I shall preserve his words, only reducing the weights and prices to the English standard."

"The mode of preparing country steel (iron), before it is drawn into wire, is by taking any quantity, and heating it in a charcoal fire until it be red hot; when it is taken out, beaten into a long thin plate, upwards of an inch in breadth, and rolled up into an oval or round form. It is then put into the fire again, well heated (the Editor supposes to a welding heat), and hammered out as before. This process is repeated eight times, by which the weight is reduced to one-fifth of the original quantity[‡].

"When this is done, it is ready for being formed into wire, and is again heated, and beat into small square rods. It is heated again (to anneal it), and drawn through a small hole, in a plate of common steel, into wire, by means of pincers. In this plate there are several holes, of various dimensions, for the purpose of gradually reducing the wire to the size required.

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[*] From the same work.

[†] Iron wire no doubt, though miscalled steel.—EDITOR.

[‡] This process is exactly similar to that adopted by a Mr. Davis, of Windsor, who was blacksmith to his late Majesty there. His object was to make *fine iron*, fit for making keys, and which were afterwards case-hardened. A rod of iron was driven into the centre of the coils, to hold them by in heating and forging them. By this means the quality of the iron was greatly improved, and its uniformity ensured.—EDITOR.

"After it has been once drawn, it is necessary to heat it again, before it can be drawn a second time, which is done through a hole somewhat smaller than the former one. It afterwards requires no farther heat; but is drawn eight or ten times more until it be sufficiently fine; and this is partly ascertained by the sound it gives, when struck by the finger, on being stretched out.

"At the time of drawing it through the plates, a small quantity of oil is applied to it, to make it pass easily.

"The length of time taken up in making four pieces of wire, nearly of the same weight, and as fine as the larger of the specimens (its weight 169 grains, its fineness two grains to a foot), will occupy one man four days. One rupee weight (177 grains) of this wire sells for one Sulany Fanam (8d.) The price of the smaller one is double that of the other specimen, being much finer."

XXXVI.—*On a Rolling-Press for the use of Bookbinders. Invented by Mr.* W. Burn*.

SIR, *37, Kirby-street, Hatton-garden, January 3, 1827.*

Having introduced an improvement in bookbinding, which I consider of great importance, I shall be much obliged if you would lay an account of the same before the Society for the Encouragement of Arts, &c. It is a method of rendering the books extremely compact and solid, by passing the sheets when folded, between a pair of powerful rollers, and in some cases inserted in plates of tinned iron or other metal, which method will entirely supersede the old laborious and imperfect one of beating with the hammer, the blows of which suddenly compressing the air between the leaves, creates a heat which is liable to make the printing set off, as it is termed, on the opposite pages. I have used it constantly for two months, and find it answer most satisfactorily. I shall be most happy to show the machine in operation, and specimens of its effects, to you or any gentlemen of the society who may honour me by calling to inspect it.

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* From vol. XLV. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce. The society voted its silver Vulcan medal to Mr. Burn.

I am, sir, &c. &c, &c.

A. Aikin, *Esq. Secretary, &c. &c.* William Burn.

A committee met at Mr. Burn's house, for the purpose of examining the rolling-press employed by him as a substitute for the beating which books require previous to being bound. The press consists of two iron cylinders about a foot in diameter, adjustable in the usual way, by means of a screw, and put in motion by the power of one man, or of two, if more convenient, applied to one or two cranked handles. In front of the press sits a boy who gathers the sheets into packets, by placing two, three, or four upon a piece of tin plate of the same size, and covering them with another piece of tin plate, and thus proceeding by alternating tin plates and bundles of sheets till a sufficient quantity have been put together, which will depend on the stiffness and thickness of the paper. The packet is then passed between the rollers, and is received by the man who turns the winch, and who has time to lay the sheets on one side, and to hand over the tin plates by the time that the boy has prepared a second packet. Among other books that were pressed in presence of the committee was a minion Bible, which was passed through the press in one minute, whereas the time necessary to beat the same would have been twenty minutes. It is not, however, merely a saving of time that is gained by the use of the rolling press, the paper is made smoother than it would have been by beating, and the compression is so much greater, that a rolled book will be reduced to about five-sixths of the thickness of the same book if beaten. A shelf, therefore, that will hold fifty books beaten in the usual manner would hold nearly sixty of such if rolled in Mr. Burn's manner, a circumstance of no small importance, when it is considered how large a space even a moderate library occupies, and the book-cases are an expensive article of furniture.

XXXVII.—*On the Manufacture of Glass in India.* By FRANCIS BUCHANAN, *M.D.*[*]

"I WENT to Chinapatam or Chinapattana, which was formerly the residence of a Polygar family, who seem to have risen into power about five centuries ago.

"Glass-ware is one of the manufactures of this place. It is made by two operations. In the first, from the raw materials are formed masses of glass; in the second, these masses are wrought up into small bottles and ornamental rings for the arms of women.

"Two or three of their furnaces are in general constructed in the same building, which is erected in form of a terrace against one of the walls of a yard, and which, where there are three furnaces, may be six feet high, twelve broad, and twenty-six long. The furnace is arched over, and in the centre of the summit has a round opening, about two feet in diameter. This is covered by a flat stone, in the centre of which there is an aperture. Near the level of the surface of the ground, within the furnace, is a shelf or platform, which has also an aperture in its centre. This platform thus divides the furnace into two different cavities, the lower of which contains the fuel, which is introduced through an opening at the bottom of a niche, or arched vault, that is formed in the front of the terrace. The crucibles containing the materials are introduced at the opening in the summit of the furnace, and placed in a circle on the platform. This opening is then closed with the flat stone, and the air is excluded by covering the stone with moist clay. The small hole in the stone is however left open. The fire-place is then filled with wood, and the fire is managed according to the nature of the materials which the crucibles contain.

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[*] From the same work which we have extracted his account of the manufacture of iron and wootz from.

" For making green glass take of the following articles according to apothecary's weight :—

	lb.	*oz.*	*dr.*	*scr.*	*gr.*
Broken glass	14	9	0	0	0
Banaji Callu, powdered white quartz	14	9	0	0	0
Loha (an old button, like brass, was given to me as a specimen)	0	3	2	1	13
Copper	0	2	9	1	16
Cariculla, iron ore with manganes	0	2	1	2	2
Soula, or impure soda	29	6	0	0	0
	58	11	5	2	11

" This is the charge for one crucible.

" In making red glass the *loha* is left out. Forty-four crucibles stand in one furnace. A small quantity of the materials is assayed in the furnace used for blowing the glass*, and if the soda prevails too much, an addition is made to the quartz.

" In order to vitrify these materials, burn on the first day ten bundles of firewood. Next day put out the fire by stopping the access of air to the furnace. Next day put in fresh wood and keep up the fire for eight days ; but no supply of fuel is given at night. The fire of course goes out towards morning. Afterwards the fire must be kept up night and day, till the glass be melted ; which is known by putting an iron rod into the crucibles through the small hole in the flat stone. This requires from four to six days more. The fire at first is put out with a view of preventing, by this means, the glass from being injured by the smoke : but it is not easy to conceive any chemical operation more injudiciously conducted than this is. The alkali is never saturated, and effloresces from the glass when that is kept any length of time. Each crucible ought to produce forty-one pounds, three ounces, four drachms, two scruples, and eight quarters of glass, worth seven sultany fanams, or four shillings and eightpence halfpenny.

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* Figures of both these furnaces will be given in the sequel to these extracts.

"The contents of one crucible for black glass are:—

	lb.	*oz.*	*drs.*
Quartz	14	9	0
Soda	29	6	0
Broken glass	22	1	4
	66	4	4

"In eight or nine days this is vitrified by a fire burning constantly, and produces about forty-four pounds and a half, worth four and a half fanams, or a little more than three shillings.

"The ornamental rings are made as follows:—a circular cavity, about two feet and a half in diameter, is dug in the floor of the work-shop, and is covered by a flat dome of baked clay. In this are four perforations around its lower edge. By one of these the fuel, which is charcoal, is introduced down an inclined plane leading to it. The three other openings are for the workmen to take out the glass, which is put into a flat earthern crucible, formed like a soup-plate, and supported upon a bracket or shelf of baked clay. When the glass is melted, two workmen sit down at each of the three openings, six men in all to each furnace, with an assistant to keep up the fire. One man of each pair introduces the point of an iron rod, and turns it round among the melted glass till a sufficient quantity adheres to it. He then takes out the rod, and with one hand gives it a quick rotatory motion on a stone that is placed before him. With the other hand he applies a knife, and forms the glass into a ring round the point of the rod. He then pushes the ring into the furnace, and then gives it a quick rotatory motion, so that the liquid glass by the centrifugal force assumes an elliptic form. The rod is then withdrawn, and the ring is dilated by inserting the point of the knife between it and the rod. It is then pushed on to the point of a cone managed by the other workman, who also gives his cone a rotatory motion, and pushes up the ring upon it, till it becomes of a proper size. He then polishes it, while it is cooling, by applying his knife to the surface, all the while continuing the rotatory motion. The work is carried on with considerable dexterity, and the two men make about ten rings in a minute.

"These rings are universally worn by the women of the Decan as an ornament to the wrists, and their applying closely to the arm is considered as a mark of delicacy and beauty; for they must, of course, be passed over the hand. In doing this, a girl seldom escapes without drawing blood, and rubbing part of the skin from her hands; and as every well-dressed girl has a number of rings on each arm, and as these are frequently breaking, the poor creatures suffer much from their love of admiration; but in the female breast this is a more powerful motive than the dread of any common pain.

"The soda, or fossil alkali, is found in the soil near Madura, and at Gutalu, a town east from Mundium. In the hot season the glass-makers go to these places and prepare as much as they want. They collect the soulu munnu, or saline earth, into heaps, and near these dig three pits, which I shall call A, B, C. The pit A in the centre is a square of four cubits in extent, and one foot in depth. The pit B is circular, three and a half cubits in diameter, and two and a half in depth. The pit C is a small circular cavity, capable of containing four or five pots of water, and communicates with the pit A by means of a small channel, which can be occasionally shut up with clay. When all things are ready, the pit B is filled nearly with soulu munnu, and then is added a little water, which is mixed well with the saline earth, so as to form a thin mud. This is then put into the pit A for two hours, when the earth subsides and leaves a clear water impregnated with alkali, which is allowed to run off into the pit C. Some of this water is then put into a fourth pit, and mixed with cow-dung. The mixture is allowed to putrify for three days, and is then spread on forty mats, by means of the twig of a tree, which retains its leaves. When dry, this forms a very thin crust on the mats, which are then laid on the ground and exposed to the sun. Every day afterwards these mats are sprinkled with fifty pots of the clear brine from the pit c, procured as above-mentioned. This is continued for twenty days, when a cake of soda about half an inch in thickness, is formed all over the mats. It is very impure and sells for two paissas the cucha seer, thirteen shillings and ninepence farthing the hundred weight. It is used for washing and making glass. Large quantities of it are said to be brought from Ellandura, a town about forty miles east from Mysore."

XXXVIII.—*On Improvements in Turret Clocks. By Mr.* W. WYNN.*

SIR, Dean-street, Soho-square, London, April 17, 1827.

As I conceive that the Society of Arts will feel as much pleasure to hear of, as I have to relate, the success of the application of those improvements for which they have honoured me with their rewards, I beg to hand you a rate of going of a church clock which I have lately made and fixed in the splendid old church of Boston, Lincolnshire, in which, among many other improvements, I have introduced the escapement for which they awarded me their gold Isis medal, and twenty guineas, in 1817.

Rate of variation from

1826.—Nov. 16 to	Nov. 20,	+17″,	being 4 days,	at +6″·75	per day.
20 to	26,	+35″,	being 6 days,	at +5″·83	per day.
26 to	Dec. 2,	+43″½,	being 6 days,	at +7″·25	per day.
Dec. 2 to	3,	+ 7″,	being 1 day,	at +7″	per day.

During the above series I was with the clock, having other work to execute in the town, and continually had to be opening the case to show the machinery; yet, notwithstanding this frequent disturbance, the daily error of the above rate was only 7″·25—5″·83—1″·42, or less than a second and a half per day. The pendulum has since been altered, to correct the gaining, and the following has since been the rate of the clock :—

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* From vol. XLV. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

Rates of variation from

1827.—Jan. 30 to Feb. 3, — 1″, being 4 days, at —0″·25 per day.
Feb. 3 to 22, —13″, being 19 days, at —0″·614 per day.
22 to Mar. 5, + 2″, being 11 days, at +0″·18 per day.
Mar. 5 to 22, + 1″, being 17 days, at +0″·06 per day.

In this last series of fifty-one days, the daily error has, therefore, been 0″·684—0″·18 — 0″·864, or very little more than three quarters of a second.

The accuracy of this rate has prevented the necessity of altering the time of the clock since it was first put going from regulation, and will do so for a long time to come, which is an object of much importance; for an alteration in a public clock, although it be made to correct it, is liable to mislead those persons who are guided by it.

So much is the friction taken off in this piece of work, that the watch part, which goes eight days, whose great wheel is fifteen inches diameter, is keeping up a motion of a two seconds' pendulum, weighing 132 lbs. with a maintaining power of 15 lbs. 9 oz. which is not more than a tenth of the weight usually employed in clocks of these dimensions. And I wish to add, that it does not only keep it going, but that it goes well; for the length of the chord of the arc of vibration is twenty-four inches, while that of the angle of escapement is only 9·6 inches. This reduction of the weight of the maintaining power has not only tended to produce the accuracy of rate, but it will be the means of greatly prolonging the duration of the watch part.

I am also much gratified to state that the hammers for which the Society honoured me with another reward of twenty guineas in 1822, most fully answer my expectations. I have attached a set of them to the clock in question, the powers of which are so ample, that they produce sounds from the bells sufficiently loud to be heard in every house in the large town of Boston, which contains twelve thousand inhabitants, an object which was never accomplished before by any eight-day clock. I have also, by the application of my toothed sectors, as described in your 40th volume, and by executing the trains on genuine geometrical principles, been able to lift these hammers with weights from fifty to seventy per cent. lighter than is applied to several specimens of work executed by my contemporaries, as compared with the momenta of the hammers and of the weights severally applied—an object of great importance, as it is generally acknowledged, that to be enabled to lift the hammers of an eight-day clock sufficiently heavy to bring out the tones of the large bells of a church, it would be necessary to employ such heavy weights as to risk the crushing of the machinery in a few years,

I beg to say that the above is a statement of facts which may be most unequivocally authenticated.

I am, sir, &c. &c.

A. Aikin, Esq. Secretary, &c. &c. W. Wynn.

XXXIX.—*On a Pocket Achromatic Telescope and Microscope. By Messrs.* Watkins *and* Hill, *Opticians, &c. Charing-cross.*

This judicious combination was effected by Mr. Hill, for his own use, about ten years since; having lately, however, made some additional improvements upon it, the Editor thinks it highly desirable to bring it before the notice of the public.

This telescope is, when drawn out, a twelve inch one, but shuts up to the length of seven inches only, and is one inch in diameter, and is thus a very useful and effective instrument: and the additional apparatus which converts it into a microscope, is contained in a small case, covered with morocco leather, which is only three inches long, one inch and a quarter wide, and one inch deep, so that the whole is most conveniently portable.

Mr. Hill unscrews the first joint of the telescope, containg the four eye-glasses, from the body of the instrument, and screws on a short additional tube to the spring socket, and which socket now serves as an adjustment for the different foci of the microscope, as it before did for the focus of the telescope.

Upon the exterior end of the short tube a springing slider-holder is also screwed, and the instrument is thus readily converted into a microscope, with considerable magnifying power, and its power is farther varied by the addition of several object or eye-glasses, which also vary the powers of the telescope; and a small pair of spring forceps are also fitted to the slider-holder, to seize and hold any small object for examination; as well as a bug-box, for containing any small insect between two flat-glasses, and preserving it alive.

Altogether, this very judicious combination forms a most pleasing instrument for the use of the botanist, the entomologist, and the general traveller, and we think can hardly fail to become popular.

We recollect a contrivance of the late celebrated Benjamin Martin, for converting a telescope into a microscope, but this was exceedingly complicated, and therefore never came into general use; the beauty of Mr. Hill's contrivance chiefly consists in its great simplicity.

Transparent objects in Mr. Hill's microscope may be conveniently viewed when placed between two glass slips; and the animalcula in water, by putting the water into the cavity formed between two slips of glass, cemented together with sealing-wax placed between them, in such a manner as to leave a gap in the middle of one side or edge of them, the capillary attraction between the two glasses thus retaining the water in the gap, the glasses being so closely brought together, there being only a little sealing-wax between them, as to produce that capillary action.

Martin's telescope and microscope had a concave speculum or illuminator affixed to it, but which is quite unnecessary here, as the light of the heavens in open day, is fully sufficient for the examination of objects in the fields.

XL.—*On the Dams and Sluices of the Saymbrumbacum Tank, near Madras. By* Francis Buchanan, *M.D.*

We extract the following interesting account of this sluice or rather weir, from the same valuable work which has already furnished us with other articles for our present number.

" In the afternoon of the 23d April, 1800, I set out from Madras, in the very hot dry weather, which usually prevails at this season. After leaving the plain occupied by the houses of the Europeans, I entered a country then scorched up by a powerful sun, yet containing little waste land; for the soil being fine, produces a very good crop of rice, provided, in the wet seasons, the usual quantity of rain falls. In some places, the industry of the natives causes a verdure that is highly refreshing, by watering a few fields that are near tanks or reservoirs of water. These fields are now covered with rice, approaching to maturity; and in the rainy season they will yield another crop.

" Leaving on the right the road to *Poonamalee,* I went to *Condaturu,* near which the country assumes a very different and a very pleasing aspect. Numerous small canals from the *Saymbrumbacum* tank, convey a constant supply of water to most of the neighbouring fields, and fertilize them without the trouble of machinery. They consequently yield every year two crops of rice. The one at present on the ground will be reaped in June, and has a very promising appearance.

24th April.—" I set out early, and soon arrived at *Saymbrumbacum* tank, which is of great extent. It has not been formed by digging, like those in Bengal, but by shutting up, with an artificial bank, an opening between two natural ridges of ground. The sheet of water is said to be seven or eight miles in length, and three in width; and in the dry season is let out in small streams, as wanted for cultivation. In the rainy season it receives a supply of water from the river *Chir-nadi,* and from several small streams that are collected by a canal. As at times the water overflows, and would break down the bank by falling over it, and sapping its foundation, the natives in different places construct what they call *codies,* or sluices (weirs) of stone. These are twenty or thirty feet wide, and are lower by some feet than the other parts. On the surface they are strongly fortified by large stones placed in a sloping direction; so that the water rushes over without undermining the bank, and is conveyed away from the fields by a canal. This is a matter of the utmost importance; for there are instances where the banks of these large tanks having given way, whole villages have been destroyed by the torrent. In order, however, that when there is plenty of rain, the tank may be completely filled, a row of stone pillars is placed on the top of the sluices (weirs); and on the water rising to a level with their base, a temporary wall is formed of mud, sticks, and straw, placed between the pillars, so as to confine the water till it rises as high as the top of the bank. People watch this night and day, in order to break down the temporary bank, should any additional rain endanger the whole. The water is let out to supply the fields, by a sluice lined with cut stone or bricks, formed through the bank, on a level with the country. The inner end of this sluice is covered by a flat stone, in which is cut a conical opening, that can be shut or opened by a conical plug (or valve) affixed to a bamboo staff, and which is secured in its place by passing through holes made in cross guiding-bars, let into two pillars of stone, which rise above the level of the water in the tank. The proper name for a tank of this kind, in the *Tamul* language, is *Eray. Saymbrumbacum* tank is said to be sufficient to supply with water the lands of thirty-two villages (should the rains fail) for eighteen months. In these villages, it is said, there are five thousand persons employed in agriculture. In a country liable to famine from want of rain, a reservoir such as this, is of inestimable value.

" The late collector, Mr. Place, though he augmented the revenue considerably; yet, by the repairs made on this tank during his administration, he gave great satisfaction to the inhabitants.

XLI.—*On a Face-guard, for the use of Smelters, Founders, &c. Invented by Mr.* J. CALLAGHAN *.

MR. CALLAGHAN's guard is intended to preserve the face, and particularly the eyes, of smiths, founders, stokers, and others, from being injured either by the heat of the furnace, or of red-hot or melted metal, or by fragments of metal dispersed on all sides, in the action of hammering.

The guard is of two forms, either a veil, as it were, of iron wire gauze of a curved form, and fastened by a hinge to the front of the hat; or a mask, more or less complete, with the eye-holes covered with wire gauze.

There is not much novelty in the invention; spectacles of wire gauze are already in use, and eye-guards fastened by a band round the head, have been employed by persons engaged in breaking stones for the roads.

It does not, however, appear that founders, stokers, and others, whose eyes are much exposed to radiant heat from burning fuel or melted metal, are in the habit of using any precaution to protect their eyes. It appears from the concurring testimony of engine-makers, master founders, and others, members of the Society, that the eyes of persons in their employ are often seriously injured from the above-mentioned causes. J. Callaghan is himself a workman, and the Society have rewarded him in hopes that his fellow-labourers may be induced to avail themselves of the invention of one of their own comrades, though they would probably neglect the very same contrivance, if offered to them from any other quarter.

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* From vol. XLV. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

CERTIFICATES.

Bridge-road, Lambeth, Jan. 10, 1827.

This is to certify that I have had Joseph Callaghan's face-guard tried at the forge and at the air-furnace in my father's manufactory, in one instance in forging a spindle of eleven hundred weight, and in the other, in dipping metal from the air-furnace; and on both occasions the men expressed their surprise at the trifling heat which they felt upon their faces; and I do not hesitate to assert, if the description of men above-mentioned would use these guards at an early stage of their profession, they would have their eye-sight wholly unimpaired for many years.

CHARLES COLLINGE.

SIR, *Foundry, Blackfriars-bridge, Jan.* 16, 1827.

We have tried your fire-guard, and find it to answer every purpose of protecting the face and eyes from the effects generally produced by excessive heat; though simple in its construction, yet we consider it to merit the warmest approbation of Yours, &c.

MR. CALLAGHAN, WARD AND AINGER.

XLII.—*On Gilding in Oil*[*].

THIS is the name given to that species of gilding in which oil is the fluid material used to cause the gold to adhere to the article gilt.

In oil gilding, what is called *gold colour* or *gold size*, is employed, which is no other than what remains of the different oil colours in the cup in which the artist cleans his pencils. This substance is extremely *fat* and glutinous; after being again well ground and strained through fine linen, it serves as a foundation or ground upon which to lay the gold leaf; this material is to be applied to a hardened ground of paint (*teinte dure*), with a common paint brush. The gold size improves by age, as it becomes more fat or unctuous the longer it is kept.

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[*] From the *Dictionnaire Technologique*, and translated in the *Franklin Journal.*

The foregoing is the process usually adopted, but we proceed to lay before our readers another, which has been communicated to us by a very skilful operator in this art, and which is to be greatly preferred.

1st. The first operation is to give a priming coat of colour, formed by grinding white lead in oil rendered drying by boiling with litharge, and tempered afterwards with linseed oil, adding a little fat oil, and a very small portion of spirits of turpentine.

2. Grind *calcined* white lead very fine in fat oil; this must immediately be tempered with oil of turpentine, as it is subject to become thick very quickly. Three or four thin coats of this are to be given very evenly in the ornaments, and in all parts intended to be gilt. Care must be taken in applying the colour to the deeper parts of the work, that it may be even and perfect. This is the *teinte dure*, or hard ground already mentioned.

3. The gold colour or size, previously strained through fine linen, is then to be laid on very thin and even, with a soft brush which has been used for oil colours. A smaller brush must be used for the deeper parts of the sculptured or other ornaments, carefully observing to remove any hairs which may be detached from the brush.

4. Where the size is so far dried as to become tacky, the gold leaf is to be spread upon the cushion, and divided with the knife; the gold is placed on with a small block of wood, faced with cloth, called a *palette*, and lightly pressed with cotton, repairing where necessary, with pieces of gold cut small, applied by a badger's hair pencil.

5. If the articles gilt are to be exposed to the weather, as balconies, grating, statues, &c. they ought not to be varnished, as gilding in oil is more durable without, than with varnish. The heat of the sun will, after a heavy rain, cause gilding covered with varnish to craze or crack over its whole surface. Gilding in the interior of a building, as on the rails of stair cases, &c. should have a coat of spirit of wine varnish, drying it by means of a chafing dish, and then applying a coat of oil varnish.

6 As the beauty of oil gilding depends greatly upon the manner of varnishing it, this should be particularly described.

The workshop ought to be very warm; the varnish must be spread gently and evenly over the work; and a second workman should follow immediately, and warm the surface by means of a chafing dish, passing it about constantly to prevent its heating too much in one place, which would blister the varnish. This heating will cause the gold to appear distinctly, as it will render the varnish perfectly transparent, which might otherwise become white and dull.

When marble is to be gilt, as it is ordinarily polished, it does not require the priming coats. If soiled, it must be made perfectly clean; the parts to be gilt should be covered with a thin coat of good oil varnish, then with the gold size, and afterwards gilt.

Gilding in oil is suitable for domes, the outer ornaments of churches, figures in lead or plaster, grating, balustrades, balconies, &c.; and answers equally well, whether the articles gilt be exposed to, or defended from, the inclemency of the seasons. Oil gilding, however, is also used on carriages, on furniture, &c. This is called *polished varnish gilding*, and is effected as follows:—

A portion of white lead, half as much yellow ochre, and a little litharge are separately ground very fine, and the whole mixed with fat oil, thinned with a little spirits of turpentine. This, which forms the first coat, is to be spread thinly and evenly on the work.

When the foregoing coat is perfectly dry, a number of coats of hard ground (*teinte dure*) are to be given, even to ten or twelve, according to the nature of the work, to render the lower parts smooth. A day ought to be allowed between each coat, and the article should be kept in a warm place, or exposed to the action of the sun; especial care must be taken that the pores in the recesses of the wood be hidden, as well as in every other part.

When the whole is perfectly dry, the flat parts are rubbed down with a piece of pumice-stone and water, and afterwards the whole, with a piece of serge and finely powdered pumice-stone and water, until all the streaks of the paint disappear, and an even glass-like surface is obtained.

After being thus prepared, four or five coats of fine lac varnish should be given with a brush of badger's hair; this should be laid on lightly, and in a place moderately warm.

When dry, it is to be rubbed down with rushes, both on the pannels and the sculptured parts, and afterwards polished with putty, and with tripoli moistened with water, and applied by means of a piece of serge, until it is as brilliant as glass.

In a place perfectly free from dust and moderately warm, the polished work is to receive a very light, thin, and even coat of the gold size; it is impossible to make this last coat too thin, as any sensible thickness would injure the work; the brush must be carefully chosen; it must be very soft, free from all dirt, and with the hairs firmly fixed.

As soon as the size becomes tacky, which may be known by touching the back of the hand against the work, the gilding may be commenced. To cover the broader surfaces, a leaf of the book of gold is to be opened, and the edge of the gold applied to the surface, with a slight pressure, releasing and laying the whole leaf in such a way that it may be spread evenly, without tearing or doubling; this is called gilding from the book. The leaves are thus to be placed side by side, over-lapping as little as possible, but observing that every part be completely covered. When small surfaces and carved work are to be gilt, the leaf must be applied by means of cotton, or by a suitable pencil.

The gilding is to be lightly brushed over with a very soft pencil, or rather with a flat brush of badger's hair, of about three fingers width; and it may then be left to harden for several days.

The work is to be varnished with a spirit varnish, called gold lacker, or with simple seed lac varnish, warming it in the way formerly mentioned.

When the spirit varnish is perfectly dry, it is to be covered by two or three thin coats of white copal oil varnish, or of gold-coloured oil varnish, allowing two days between each coats.

Finally, the pannels are to be polished with a piece of serge, covered with tripoli and water, and a lustre given by the palm of the hand, which is to be moistened with a small portion of olive oil, taking care not to injure the gold, by rubbing one part more than another. Those parts of carriages, furniture, or sculptures, which do not admit of being polished, should have a greater number of coats of the spirit of wine varnish, and two or three of the oil varnish.

M. Monteloux-Lavilleneuve, of Paris, who has obtained great celebrity for gilding in oil, and for burnishing all kinds of varnished metal, and who has greatly improved this art, received a patent for his improvements, the term for which has expired; the following is an extract from his patent.

After the pieces are varnished and polished, he applies his gilding ground; for this purpose he heats them, and wipes them carefully whilst warm, to render it certain that not the slightest humidity remains upon the parts to be covered with the ground. In this state of perfect dryness, with a small stick, sharpened like a crayon, he places, in spots, small portions of his first ground upon the work, taking care that the quantity on each spot, and their distances from each other, shall be as equal as possible. This part of the operation must be quickly performed, that the drops first applied may not harden so as to interfere with the perfect and equal spreading of the ground; this spreading is effected immediately by first using a stump or roll of lutestring, and then a piece of velvet, which equalizes it, and diminishes its quantity as much as is necessary. Without this precaution, the gold when applied will appear black, and will lose its brilliancy. This first ground, or size, is composed of equal parts of the gold size, already described, and of boiled oil.

The next operation is to apply, in a similar way, a second coat, formed by combining together two parts of wax, and one of mastic varnish made with linseed oil: these are to be used without spirits of turpentine. The spreading of this requires that the article should be warmed in a stove.

A third coat is formed composed of one part of amber varnish, and two of fat oil, without spirits of turpentine; this, after being laid on with a brush, is to be regulated by the velvet, and some time allowed before the application of the gold. Practice alone can point out the time when it is sufficiently dry for this purpose.

The gold may be applied by means of the small cushion, formed of wood, and faced with cloth, or by a simple card, according to the habit of the workman. When the gold is on it is to be pressed with a piece of soft skin, and then with clean velvet, in order to give it the uniformity of surface and the brilliancy required. It is then left to dry in a stove room, after which it may receive one or more coats of old varnish, taking care that this be not applied until the gilding has hardened perfectly, otherwise it will absorb a portion of the varnish and in consequence lose its brilliancy. The varnishing upon gold preserves it from being rubbed, and renders it capable of being washed to remove any spots or dirt from its surface.

Remarks by the EDITOR *of the Franklin Journal.*

The experienced workman is generally able to substitute one article for another in the recipes presented to him, but those who are without experience or skill are apt to suppose that the process must fail, if there be any departure from what is written down; we add a few remarks for the purpose of correcting this error. The French are in the habit of using the oil gold size mentioned in the foregoing article, but as it is formed from the various pigments left in the washing of their brushes, it is evident that it must vary in its composition and in its colour; its use however has been consecrated by habit, which is a master of Herculean power. The gold size used in England, and in this country, we think a much better article; it is composed of red lead and fine yellow ochre, ground in fat oil, that is, a thick linseed oil, which has by age assumed a fat unctuous consistence, which gives it a peculiar fitness for this use. Gold size thus made is of the colour most suitable to hide any defects in the work; it possesses all the good properties of that used by the French, and is free from its bad ones. It may be made in large quantities, and with proper precaution be kept for years.

The rushes used for rubbing down are a valuable article, and grow abundantly in various parts of the United States, they are found in our own neighbourhood in the State of New Jersey*; though extensively used in Europe they are scarcely known to our workmen. They grow usually to the diameter of a small goose-quill and are hollow, and on their exterior surface are as sharp as glass-paper, whilst they are much finer; they may be used either wet or dry. Glass-paper is our substitute for dry, and powdered pumice-stone and water for wet rushes.

Tripoli is an earth much used in Europe for polishing, rotten stone is most commonly employed; it ought, however, previously to be carefully washed over, to free it from all grittiness.

Amber varnish we have never used, for most purposes it is inferior to copal, but as a ground for gilding on, it may be superior.

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* Those used in Great Britain come from Holland, and hence are called Dutch rushes.

Where work requires much rubbing down, many coats of colour are necessary, but in most instances they may be much less numerous than directed in the preceding article; on metal they cannot be needed, and on wood much depends upon the closeness of its grain, and the truth with which it is worked.

XLIII.—*On Packing Seeds for Exportation, so that they may retain their Vegetative Property*[*].

THE lovers of plants, or those who wish to have seeds transported to distant countries, ought to observe the precautions which follow, in order that the seeds may germinate when they have been sown. The means of effecting this, which we are about to make known, are those which have been followed by that distinguished botanist, Mr. Soulange Bodin, who has had long experience in this business.

All seeds intended for exportation should be collected in a state of perfect maturity. The finer or smaller seeds may be enclosed in good paper bags, but those which are larger must be placed in layers in very dry sand, and the whole be packed in air-tight vessels. The stratification in dry sand, is a precaution which alone would preserve their germinating property for many years, and during the longest voyages. Saw-dust is also a good material, but it is necessary to take the precaution of placing it in an oven as we do bran, when we wish to purify it from mites, or from the eggs of other insects. Oleaginous seeds which are liable soon to become rancid, such as those of the coffee plant, the oak, nut-trees, the tea-tree, &c. require, when stratified, to be kept with great care separate from each other, in sand, which is very fine and very dry. Those which are of a middle size may be sent in their pericarps, enclosed air-tight in small cups or pots, by covers of glass fixed on with putty; or of wood, or cork, imbedded in melted wax, or which is better in melted pitch.

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[*] From the *Journal des Connoissances* and the *Franklin Journal.*

Juicy seeds must be separated from each other, as contact would, sooner or later, inevitably cause a fermentation which would destroy them. The late celebrated Dr. William Roxburgh dipped them into a solution of gum arabic, and formed them into masses; this as it hardened formed a coat, which secured them against every principle of destruction, and enabled him to transmit them from the Coromandel coast to Europe, without undergoing the slightest change.

With respect to bulbous roots and other plants with roots, which always require a length of from two to three feet in their shoots or slips, it is best to place them either in earth, taken from the spot where the plant vegetates freely, or in some other earth well divided and mixed, and rather too dry than too moist; the mould formed of the rotten trunks of trees is very good for the purpose, but it is necessary to ascertain that it does not contain insects.

Vegetables treated in this way have been brought by M. Perrottet from the South Seas and have all lived. The whole may be enclosed in little wooden casks well hooped, and covered inside and out with a bituminous coating. So situated, seeds are unalterable; and when the vessels are well closed, neither insects, external air, moisture, or even heat, can gain admittance. It is above all things necessary (notwithstanding some ill founded theories) to be careful not to use fresh moss, or immersion in wax, or in pitch; plants sent in this way from the torrid zone to France, have arrived either decayed or quite dried up.

Remarks by the Editor *of the Technological Repository.*

The mode of preserving roots in sand, was practised by Mr. Way, of Bridport, in Dorsetshire, many years ago with great success; and he was rewarded by the Society of

Arts, for communicating his invention. Mr. C. Whitlaw has also exported potatoes closely packed in casks, in the earth in which thew grew, from North America to the West Indies, with great success. We must, however, object to the exclusion of the use of moss, above-mentioned, as we know that Mr. W. Salisbury packs trees in the moist *sphagnum palustre*, or the white moss, of bogs or marshes, with the greatest possible success. And we have seen a whole collection of trees imported into this country from North America, growing most vigorously on being planted. Indeed they continued vegetating and throwing out shoots the whole time they were enclosed in the moss, which possesses a most extraordinary anti-septic quality, and effectually resists decomposition.

XLIV.—*On a Machine for Boring the Felloes and Naves of Wheels, and Cutting the Tenons and Shoulders on their Spokes. Invented by Mr.* JOHN SETTON, *of Pendleton, South Carolina*[*].

WE have not a drawing of Mr. Setton's machine, and to give a clear idea of a complex instrument by description alone, is a rare talent; from the description furnished us by the inventor, the object and utility of the apparatus will be evident, although its precise form may not be fully understood.

A frame, similar to that called the wheel-gallows is made, for the purpose of securing the nave to be bored; the top piece of this frame is secured by screws of wood or iron, instead of the common key-wedge, which allows it to be raised or lowered at pleasure. A bench and frame are placed at right angles with that upon which the nave is secured; upon this frame a carriage is made to traverse backwards and forwards, being confined in its course by ledges, rebates, or grooves; this carriage is about a foot long, and at the top of it is a perforation from end to end, to receive the shank of an augur, which is turned by means of a crank. The carriage is drawn forward by means of a weight attached to a line passing over a pulley, and when the hole is bored of a sufficient depth, a treadle serves to draw the carriage back. On the opposite side of the nave, the bench or frame is continued and supports a second carriage, similar to that described, but so inclined as to give, in boring, the intended dish to the wheel. Two persons may bore the nave at the same time on these opposite sides, and will be able to effect the whole in four minutes. The patent augur is the best, but other kinds may be used.

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[*] From the *Franklin Journal.*

Before the nave is secured by the screws, it is raised to its place by square blocks; on the upper one a plate of iron is fixed, marked so as to show the number of holes to be bored, and a nail is driven into the nave, to guide in turning it round to a proper distance. A pin passes through the centre of the nave, and blocks to preserve it in its place. The holes in the felloes to receive the spokes, and those in their ends for the dowels, are bored in the same way, there being such appendages as are proper for fixing them, for the purpose of boring them with truth.

To cut the tenons and shoulders on the spokes, the wheel is put into the frame and fastened as for boring the nave, and the tenon augur, or a hollow augur, is put into the carriage; this augur is hollowed to the exact size for the tenon, and the outer end is made of cast-steel, formed in a proper manner for cutting. There are also suitable contrivances for holding the spokes steady, and a stop when the boring is of a proper depth, so as to ensure the wheel being made of a true circular shape.

This machine will lay off and bore the nave; lay off and bore the felloes, and cut the tenons and shoulders on the spokes more correctly, than can be done by measurement: and the spokes are the stronger from being shouldered on both sides. With this machine a good workman can make a wheel in five hours and a half, after being furnished with the nave turned, and the felloes and spokes in the rough.

LIST OF PATENTS FOR NEW INVENTIONS,

Which have passed the Great Seal since Feb. 21, 1828.

To Caleb Hitch the younger, of Ware, in the county of Hertford, brick-maker; for an improved wall for building purposes. Dated Feb. 21, 1828.—To be specified in two months.

To George Dickenson, of Buckland Mill, near Dover, in the county of Kent, paper manufacturer; for an improvement or improvements in making paper by machinery. Dated Feb. 21, 1828.—In four months.

To Angelo Benedetto Vanhera, of Cirencester-place, Fitzroy-square, in the county of Middlesex, professor of music; for certain improvements on the harp-lute, and Spanish guitar. Dated Feb. 21, 1828. In six months.

To David Bentley, of Pendleton, in the county of Lancaster, bleacher; for an improved method of bleaching, and improvements in machinery adapted to bleaching and finishing linen or cotton yarn, and goods. Dated Feb. 21, 1828.—In six months.

To William Brunton, of Leadenhall-street, in the city of London, civil engineer; for certain improvements on furnaces for the calcination, sublimation, or evaporation of ores, metals, and other substances. Dated Feb. 21, 1828.—In two months.

To John Levers, of Nottingham, machine maker; for certain improvements in machinery for the manufacture of bobbin-net lace. Dated March 3, 1828.—In four months.

To William Pownall, of Manchester, in the county of Lancaster, weaver; for improvements in making healds, for weaving purposes. Dated March 6, 1828.—In four months.

To Bernard Henry Brook, of Huddersfield, in the county of York, civil engineer; for improvements in the construction and setting of ovens or retorts, for carbonizing coal, for the use of gas-works. Dated March 6, 1828.—In six months.

To William Rogers, of Norfolk-street, Strand, in the county of Middlesex, a Lieutenant in our royal navy; for certain improvements on Anchors. Dated March 13, 1828.—In six months.

To Robert Griffith Jones, of Brewer-street, Golden-square, in the county of Middlesex, gent.; who, in consequence of a communication made to him by a certain foreigner residing abroad, is in possession of a method of ornamenting china, and certain other compositions, which he denominates Lithophania translucid, or opaque China. Dated March 13, 1828.—In two months.

To George Scholefield, of Leeds, in the county of York, mechanic; for certain improvements on, or additions to, looms, for the purpose of weaving woollen, linen, cotton, silk, and other cloths. Dated March 15, 1828.—In six months.

To Nathan Gough, of Salford, in the county of Lancaster, civil engineer; for an improved method of propelling carriages or vessels, by steam or other power. Dated March 20, 1828.—In six months.

To Samuel Clegg, of Chapel Walks, Liverpool, in the county of Lancaster, civil engineer; for certain improvements in the construction of steam engines, and steam boilers and generators. Dated March 20, 1828.—In six months.

GILL'S
TECHNOLOGICAL REPOSITORY.

XLV.—*On the Microscope. By the* EDITOR.

WITH A PLATE.

(Continued from page 201.)

Mr. T. Carpenter's observations on the natural history of the Hemerobius Perla, termed, in its larva state, the Plant Louse Lion.—The Editor lately mentioning to Mr. Carpenter the fact of his finding upon the edge of the leaf of a plant, growing in a pot standing outside his window, a row of small cylindrical bodies with rounded ends, affixed to the leaf, and suspended on one side of it, by means of minute bent threads, as shown in plate IV. fig. 1, he immediately knew them to be the eggs of this singular and beautiful insect; and mentioned that they not only affixed or agglutinated their eggs to the edges of leaves, as in this instance, by threads discharged from their abdomen; but that they also erected them upon slender stems, distributed over the surfaces of such leaves as the aphis had previously laid its eggs upon, and as shown in fig. 2; and thus kept them out of the reach of the young aphides, which otherwise would have destroyed them, by means of the piercers attached to their rostrums, before they were hatched, and had attained their larva state. The young aphides, immediately on their exclusion from the eggs, commence feeding upon the juices of the leaf, by the assistance of the tubes and piercers contained within the proboscis with which each is furnished; and, under the microscope, present the appearance of a flock of sheep feeding upon an extensive plain. Whilst the aphides are thus luxuriating, the larvæ of the hemerobius are excluded from their eggs, and immediately crawl down the slender props upon which they rested, and like a horde of savages commence devouring the aphides, by plunging into their delicate bodies two powerful fangs, with which they are furnished at their heads, and which are hollow, and have apertures near their points, through which they suck every portion of the juice contained in the bodies of the unfortunate aphides. In this larva state these insects may indeed very deservedly be termed *Plant Louse Lions,* in consequence of their feeding so voraciously upon the aphides; and by thus thinning them, they are doubtless of great service in the general economy of nature. Mr. Carpenter showed the Editor under his microscope, as an opaque object, a leaf thus occupied by the suspended eggs of the hemerobius, and several white skins of aphides also attached to it. He also exhibited to him one of the larvæ separately, mounted as an opaque object, and furnished, as above-mentioned, with its two fangs. These larvæ, in common with most others, undergo the change into the pupa state, and afterwards become perfect winged insects. Their fangs in the larva state have a most formidable appearance under the microscope, and greatly resemble those of the *formica leo* or ant lion.—With respect to the perfect insect or fly, when viewed under the microscope as an opaque object, and the light was thrown obliquely upon its wings, it presented one of the most splendid appearances the Editor ever beheld; affording the irridescent colours of the most brilliant minerals, combined also with a most exquisite nervous structure. The wings, when viewed as transparent objects, were also exceedingly beautiful. A figure of one of them is given in Adams's work on the Microscope, edited, with additions, by Messrs. Jones, in plate XV. of that valuable work.

Mr. T. Carpenter's anatomical displays of the internal parts of Insects.—Mr. Carpenter has lately employed himself in this highly interesting pursuit, and has indeed succeeded to a degree he little contemplated when he first began his investigations. He has operated upon the bodies of various insects, such as moths, flies, beetles, &c., by carefully cutting them open, and washing them in water with the help of a delicate camel's hair brush, and particularly by conducting his researches with the greatest patience and assiduity; and when he has cleansed the bowels sufficiently by this means, he places them between two slips of glass, in the moistened state, and secures the glasses together, by winding a piece of twine around them repeatedly, and tying it fast. When the objects have become sufficiently dry, by remaining in this state for a due length of time, he unbinds the twine, and opening the glasses, by this means very frequently succeeds in dividing or separating the bowels into halves, each half being cemented to a slip of glass by its own natural gluten. In this manner he has produced a number of highly interesting transparent objects for his microscope; and we cannot but lament the almost total impossibility of affording our readers any adequate idea of their beauty by figures of them, they being of so very minute a structure, and their blood-vessels ramifying or branching out into parts too minute even for powerful magnifiers to exhibit. We must therefore content ourselves with merely selecting a few of a simpler kind, from the many specimens which Mr. Carpenter has kindly afforded us the use of; and must advise our readers to follow the methods adopted by Mr. Carpenter in order to possess themselves of similar beautiful objects to his for the microscope.

In plate VI. fig. 3 represents a portion of the intestines of the cream-coloured spotted tyger-moth, viewed as a transparent object, and in which some of the larger blood-vessels are seen. Fig. 4 is part of a blood-vessel taken from the humming-bird-moth, magnified considerably, and in which its muscular fibrous structure is made evident both in the longitudinal and the transverse threads or fibres with which it is intersected, very much resembling coarse canvass; in other specimens of them, the fibres were sometimes crossed nearly at right angles, as here shown, and sometimes obliquely; and frequently, in others, where more than two thicknesses presented themselves, a curious wavy appearance was produced from the crossing lines, greatly resembling the waterings seen in woven silk.

Mr. Carpenter, however, has most perfectly succeeded in the preparation of opaque objects, some of which are indeed of unrivalled beauty. Fig. 5 represents part of one of the plates forming the body of the common house-fly, in which a blood-vessel is seen as proceeding from a central one, and ramifying to a great degree of minuteness; it is, however, quite impossible for us to represent its still more minute ramifications, which even elude highly magnifying powers to discover them. The blood-vessels fortunately are white, and appear beautifully distinct in the real object, being made manifest by the dark colour of the plate to which they are attached in the insect.

He has produced the finest display in the anatomy of the blood-vessels, the muscles, tendons, &c. of that despised insect the common black house-beetle, some of which having been caught by his housemaid in the ordinary manner, he caused her to destroy life in them quickly, by pouring boiling water upon them. He then cut their bodies open, and proceeded to cleanse them in the manner above described, leaving all the internal parts connected with the outward coverings in their natural situations, undisturbed as much as possible. These he placed between glass slips, and bound them together as above-mentioned, and on opening a pair of the slips, and placing the preparation they had contained under his microscope, as an opaque object, he afforded the Editor one of the highest gratifications he has ever enjoyed! The minute ramifications of the vessels, nerves, &c., were infinite, and most admirably displayed, so that an expert comparative anatomist could have experienced no difficulty whatever in clearly defining them.

Mr. Carpenter has also preserved and mounted as opaque objects, some of what at first appeared to him merely a black mass of refuse matters, separated in the washing and clearing of the adhering parts of the subject. These again afforded him most exquisite objects, the minute arteries and veins branching over the different parts being most perfectly displayed. He will, therefore, in future, throw away none of these loose parts without previously subjecting them to the test of his microscope.

On Configurations produced by the triple mixture of Salts, termed by the Editor the "Microscopic Kaliedoscope.*"—The remaining figures in plate VI. from 6 to 20, are intended to give some idea, though a very inadequate one, of the great variety of configurations which continually present themselves to the eye of the observer whilst viewing the progress of the evaporation of the water from a drop of this mixture of salts, when under the microscope. In them will be found combinations arising from the crossing of two lines, either at a right angle, or at an oblique one; also others, produced from the meeting of three or six lines in one common centre, and thence branching out in many different ways. From the fugitive nature of them, however, it is impossible to afford accurate representations of the *rich ornamental finish and decoration* which is finally given them in their progress, and which must be seen to be comprehended. We cannot but think that a *polarity* greatly influences these *symmetrical arrangements.*

On the Podura.—Mr. T. Carpenter has kindly furnished the Editor lately with some of the scales of this insect, and which are deemed to be amongst the most difficult objects to discover their peculiar conformation in the microscope, as it requires not only a good instrument, but also a considerable skill in the peculiar management of the light, otherwise their delicate wavy lines are entirely invisible. He has placed them between two slips of Dutch plate glass, one of them less than the thirtieth part of an inch in thickness, so that they are perfectly manageable under a single lens of that focal strength; and, in the Editor's Varley's microscope, are perfectly distinguishable.

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* See page 197 of our last number.

Mr. Carpenter wishes to rectify an error he has inadvertently fallen into. The podura, as is well known, haunts cellars, and is commonly to be found upon the corks of bottles. However, as they are exceedingly nimble, and difficult to secure, on account of the great leaps they are enabled to make, by a singular appendage to their abdomens, so he thought of entrapping them by laying hollow bones in his wine-cellar, for them to enter; knowing that such insects were partial to preying upon bones. This accordingly proved to be the case, but an unexpected result also occurred; for the poduras had become so fat, from feeding upon the oily matters contained in the bones, that it is exceedingly difficult to free their scales from it, and, in consequence, their distinctness of conformation is very greatly obscured thereby. Mr. Carpenter therefore wishes those friends to whom he has recommended the above mode of catching the poduras, to be warned of the evil consequences arising therefrom, and to be contented with the old methods of procuring them.

On an improved Apparatus or Slider for viewing the Animalcules in water under the Microscope.—The Editor has formerly described an apparatus consisting of two slips of glass cemented together, with a piece of card laid between them, and having a gap or notch cut in one side of it, to form a kind of cell, into which cell, water, containing animalcules in it, being placed, the water was held in the cell by the capillary attraction, and was thus prevented from falling out, when the slider was laid horizontally on the stage of the microscope.

The Editor, some time since, furnished Mr. Gould, at Mr. Carey's, the optician, in the Strand, with one of these sliders, and which he immediately adopted in his microscopic apparatus. He has since, however, laid aside the interposed card, and now merely cements the two slips of glass together, by heating them, and coating them with sealing wax, excepting a gap or cavity in one side of each, in the middle of the slip; and then again heating them, he joins them together, thus forming a cavity which holds a thinner stratum of water than when the card was interposed. This is a great improvement on the original method; and when one of the glass slips is only the twentieth or thirtieth part of an inch in thickness, as is the case with some of the Editor's making for his own use, it forms an exceedingly commodious cell for this purpose. Mr. Gould clears out the water by means of a slip of paper introduced between the two glass slips.

On the Compound Microscope and Telescope.—The Article in our last number, page 239, on this subject, naturally led some of those opticians who sold similar contrivances, to mention them to the Editor; and, amongst others, Mr. Philip Carpenter, of Regent Street, was one of the first to convince him that he had long since applied a contrivance to a walking-stick telescope, to enable it to answer the purposes of a microscope likewise. Messrs. Jones, of Holborn, have also put in claims to the application of the first eye draw-tube of twelve and eighteen inch telescopes to the purposes of microscopes, many years since; and referred him to Adams's work on the Microscope, edited, with considerable additions, by them, where in plate VIII. and page 125, will be found a figure and description of the late Mr. Benjamin Martin's combination of a telescope and a microscope, and which the Editor had twice alluded to in his article. They, however, do not seem to consider it as being complicated; and they think that every eye is not capable of viewing transparent objects by the natural light of the heavens, especially against a glowing and a dazzling sky; and therefore they prefer his employment of an illuminating speculum, by the aid of which, the objects may be viewed in the usual manner of table microscopes.

On the first inventor of the Engines for making Draw-tubes for Microscopes, Telescopes, &c.—Messrs. Jones communicate the important fact, that Mr. Lovell Martin, son of Mr. Benjamin Martin, invented the admirable engine for drawing truly the brass, plated metal, and other tubes for microscopes, telescopes, &c. and which is now in such universal employment for that purpose.

On the Achromotic Microscopic Magnifiers.—Mr. William Jones, who is acquainted with the numerous contrivances and publications of the late celebrated Mr. Benjamin Martin, has informed the Editor, that this scientific optician made many trials to adapt achromatic magnifiers to microscopes, and which were executed by his then apprentice, the late ingenious Mr. Kimball; but that he ultimately found he could obtain *greater magnifying powers*, with *more light*, and *perfect definition*, by employing *small single lenses*, than with the compound ones. In this opinion the Editor is disposed to concur, and especially when single lenses are mounted in the very judicious manner adopted by that late eminent workman, Mr. Samuel Varley, in the microscope in the Editor's possession, and which have greatly surprised the most competent judges of microscopes, such as Professor Amici and Mr. T. Carpenter, from the *large field of view* they afford, owing to the eye of the observer being able to approach close to the lenses; but which is by no means the case with the single lenses mounted in the usual manner. This improvement will be found described in vol. IX. page 261, of the *Technical Repository*, and figures of the various parts accurately drawn by Mr. A. Pritchard, and engraved by Mr. E. Turrill, will be found in plate X. of that volume, figs. 10, 11, and 12; from an inspection of which, this simple and facile method of construction will be readily understood.

(*To be continued.*)

XLVI.—*On the Culture of the Cocoa-Nut and the Betle-Nut Palms, in India. By* FRANCIS BUCHANAN, *M.D.*[*]

"21*st August*.—I remained at *Chica Nayakana Hully* investigating the management of the palm-gardens in its vicinity. These occupy by far the greater part of the watered land in the districts called *Honawally, Budihalu, Hagalawadi,* and *Chica Nayakana Hully,* with a considerable portion of land in *Sira* and *Gubi.* In the dry season they require the assistance of the *Capily*[†], the water in the reservoirs seldom lasting throughout the year.

"Cocoa-nut palms are planted in rows round the betle-nut gardens, and also separately in spots that would not answer for the cultivation of this article. The situation for these gardens must be rather low; but it is not necessary that it should be below a reservoir; any place will answer in which water can be had by digging to the depth of two men's stature. The soil which is here reckoned most favourable for the cocoa-nut, is a red clay mixed with sand. It must be free from lime and saline substances. Other soils, however, are employed, but black mould is reckoned very bad. The cocoa-nuts intended for seed are cut in the second month after the winter solstice. A square pit is then dug, which is sufficiently large to hold them, and is about a cubit (eighteen inches) in depth. In this, fifteen days after being cut, are placed the seed-nuts, with the eyes uppermost, and contiguous to each other; and then earth is thrown in, so as just to cover them, upon which is spread a little dung. In this bed, every second day for six months, the seed must be watered with a pot, and then the young palms are fit for being transplanted. Whenever, during the two months following the vernal equinox, an occasional shower gives an opportunity, by softening the soil, the garden must be ploughed five times. All the next month it is allowed to rest. In the month following the summer solstice, the ground must again be ploughed twice; and next month, at the distance of forty-eight cubits in every direction, there must be dug pits a cubit wide, and as much deep. In the bottom of each a little manure is put; and the young plants, having been previously well watered, to loosen the soil, are taken up, and one is placed in each pit. The shell still adheres to the young palm, and the pit must be filled with earth so high as to cover the nut. Over this is put a little dung. For three months the young plants must be watered every other day, afterwards every fourth day, until they are four years old, except when there is rain. Afterwards they require no water. Every year the garden is cultivated for *ragy*, *udu*, *hessaru*, or whatever other grain the soil is fitted for, and is well dunged; and at the same time four ox-loads of red mud are laid on the garden, for every tree that it contains, while a little fresh earth is gathered up towards the roots of the palms. The crop of grain is but poor, and injures the palms; it is always taken, however, as, in order to keep down the weeds, the ground must at any rate be ploughed; as the manure must be given, and as no rent is paid for the grain. On this kind of ground the cocoa-nut palm begins to bear in twelve or thirteen years, and continues in perfection about sixty years. It dies altogether after bearing for about a hundred years. They are always allowed to die, and when they begin to decay, a young one is planted near the old one, to supply its place. In this country, wine is never extracted from this palm, for that operation destroys the fruit, and these, when ripe, are considered as the valuable part of the produce. A few green nuts are cut in the hot season, on account of the refreshing juice which they then contain, and to make *coir* rope; but this is also thought to injure the crop. The coir made from the ripe nuts is very bad, and their husks are commonly burned for fuel. A sufficient quantity of coir for country use is made by people of the low cast called *Whalliaru*, who collect the green husk of the nuts which have been cut for juice, or thrown down by the monkies. In order to rot the substance connecting the fibres, they steep the husks for six months in water, and having then placed them on a stone, they beat them with a stick, and finally rub off with their hands all the adhering substance. The fibrous part, or coir, is then fit for being twisted into yarns.

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[*] From his "Journey from Madras, through the Countries of Mysore, Canara, and Malabar."

[†] Or a leathern bucket, drawn out of the well by two oxen, walking down an inclined plane at the time.

The crop begins in the second month after the summer solstice, and continues four months. A bunch is known to be ripe when a nut falls down, and it is then cut. Each palm produces from three to six bunches, which ripen successively. A middling palm produces from sixty to seventy nuts. As the nuts are gathered, they are collected in small huts, raised from the ground on posts. When a merchant offers, the rind is removed, at his expense, by a man who fixes an iron rod in the ground, and forces its upper end, which is sharp, through the fibres; by which means the husk is speedily removed. He then, by a single blow with a crooked knife, breaks the shell, without hurting the kernel, which is then fit for sale, and is called *copra.* A man can daily clean thirteen hundred nuts. From 20 to 30 per cent. of them are found rotten. These kernels sell to the merchant at from thirty to forty fanams a thousand. The merchants frequently advance to the whole amount of the expected produce, and sometimes are forced to wait for repayment till a second crop; but the price they allow is in general low, and the proprietors of gardens that are in easy circumstances prefer taking their chance of the market.

"The old branches and leaves, of which a certain number annually perish, are allowed to drop spontaneously, and are here used chiefly for fuel. They are also used to thatch the huts in the garden; but in this country are seldom if ever employed in the houses of the natives. *The shells are made into charcoal, which is the only kind that the goldsmiths use.*

To stock a garden of two hundred trees, requires two men, three oxen, and a buffalo. These do no other work, but are sufficient for the whole cultivation. It must be observed, that if the palms are planted at the distance stated by the cultivators, a garden containing two hundred trees would occupy above twenty-three acres; and the dry crop of grain may be considered as fully equal to the whole expense of cultivation. A garden of good soil pays seventy fanams for the hundred trees; and of a very bad soil, such as that containing lime, the hundred trees pay only twenty fanams; and all intermediate rents are paid according to the value of the soil. At the first rate, the tree pays as rent about five pence halfpenny, and the acre not quite four shillings. Take the average produce of a middling tree, as the neat produce of a tree on a good soil, and we have sixty-five nuts, the average price of which, at thirty-five fanams a thousand, will be eighteen pence halfpenny, from which deducting the rent, each tree is worth about thirteen pence a year to the proprietor. To judge from appearance, however, I am inclined to think that the trees are in general planted nearer to each other.

"The cocoa-nuts that are planted around betle-nut gardens are not so productive, but pay a similar rent, which, however, is always low, in proportion as the soil is bad. They are planted in order to shelter the betle-nut palms.

"The betle-nut palm, or *areca,* thrives best in the rich black mould called by the natives *eray,* or *krishna bumi.* The natives here look upon it as matter of indifference, whether or not, on digging a little depth water may be found in the soil. All that is required, is to have a proper supply of water, either from the reservoir, or by means of machinery.

"In the second month after the winter solstice, the nut intended for seed is cut, and having been put in a heap, is for eight or ten days kept in the house. A seed-bed is then dug to the depth of a foot, and three inches of mould is removed from the surface, which is then covered with a little dung. On this the nuts are placed with their eyes uppermost, and close to each other. They are then covered with an inch of mould, and for three months are watered every other day. The seedlings are then three or four inches high, and must be transplanted into a fresh bed, that is prepared in the same manner; but in this they are placed a cubit distant from each other. Here they grow for three years, receiving water once every other day; and once a month they are cleaned from weeds, and have a little dung.

"One year after planting the seed, the ground that is intended for the garden must be dug to the depth of a cubit, and the soil exposed for two months. Young plantain trees (*musa*) are then placed in it at sixteen cubits' distance from each other, and it is surrounded by a screen of cocoa-nut palms, and of *jack (artocarpus integrifolia)*, lime, and orange-trees, which are defended by a hedge of the *euphorbium tirucalli*, or milk-bush. At the same time, seeds of the *agastray*, or *æschynomone grandiflora*, are planted throughout the garden, at the distance of four cubits. When there is no rain, the garden must once in fifteen days be watered by channels made for the purpose. In the second month after the summer solstice of the third year, the young arecas are fit for transplantation. Then, throughout the garden, and at the distance of sixteen cubits; and in the middle between every two plantain trees are formed pits, a cubit deep, and a cubit wide. In each of these pits a young areca is put, and it must be carefully raised from the seed-bed, with much earth adhering to its roots; and after it is placed, the pit must be filled with earth, and then receive a pot of water. The young arecas are then between two and three feet high, and have four or five branches. If there be water in the reservoir, an irrigation once a month is sufficient; but the *capily* must be used once in ten days, as the waterings given by it are but scanty. For three years afterwards the whole garden must be completely hoed twice annually. At the one hoeing, for every four arecas, it must have a bullock-load of dung; and at the other hoeing, every tree must be allowed an ox-load of red soil. The mud of reservoirs is here thought to be very bad for a betle-nut garden. Ever afterwards, the garden is hoed completely once a year only, and is then manured with dung and red earth. At the intermediate period of six months, it is hoed near the trees, and has a little dung. At the end of the first three years, the agashay trees are cut. The plantains are always reserved; but, as the old stems are cut, which is always done in from twelve to eighteen months, the young shoots are conducted to a distance from where the parent was originally placed; and when the garden is twenty years old, in these spots are planted other young arecas, to supply the places of the old ones when they decay. This second set is again supplanted by a third growing where the first set did, and thus a constant succession is preserved. In a new garden, the areca begins to bear fruit in nine years; but fourteen or fifteen years are requisite to bring forward those which are planted among old trees. They continue to bear for sixty or seventy years; but after having been twenty-five or thirty years in perfection, they begin to decay.

"In a few gardens here, the mode of raising betle-nut that is in use at *Madhu-giri* has been adopted; and it is said to be preferable, but is attended with much trouble. The plantain tree, however, is always preserved, and is considered as useful to the old palms. *Yams*, or *dioscoreas*, are considered as prejudicial; but I observed them in several gardens, the proprietors of which said they allowed them only to climb on the old palms, and to these they did little harm.

"There are annually two crops of betle-nut; one in the second month after the summer solstice, the other in the two months which precede the shortest day. The last crop is superior both in quantity and quality. The nut, on being cut, is skinned in the course of two days, and put into a large pot, with as much water as will cover it two inches. It is then boiled for about three quarters of an hour, until a white scum arises. The largest are then cut into eight pieces, and the smallest into two, with the others in proportion to their size. During the four following days they are spread out in the sun to dry, and every night they are gathered in a heap. When the fruit has been allowed to approach too near to maturity, the nut loses its colour; and a deceit is attempted, by adding a little reddle to the water in which it is boiled. This frequently deceives the consumer, but never the experienced dealer; and seems to be done purposely to enable him to defraud the unwary.

"A garden of one thousand trees, allowing eight cubits square for each tree, ought to contain rather more than three and one-third acres; but a young garden, containing trees at sixteen cubits, will require eight and a half acres. If it receive a sufficient supply of water from a reservoir, it requires the constant attention of two men and two buffaloes; but if it be watered entirely by the capily, it requires an addition of two men and four oxen. The rent in the first case is twenty fanams for the hundred trees, and in the latter case only twelve. The labour of two men and four oxen is therefore estimated at one hundred and thirty fanams a year, and we may allow one hundred and twenty for two men and two buffaloes. The great digging of the garden requires additional labourers to the amount of forty fanams. The nut is prepared by a man who recevies two *dudus* for every *maund*, or about six fanams for the garden. The bunches of nuts are cut by a person of the *Bayda* cast, who gets three fanams for the thousand bunches, or about ten fanams for the garden. The whole annual expense therefore of a garden of one thousand trees, is about fonr hundred and twenty-six fanams. The produce is reckoned from forty to sixty maunds; the average is fifty, which, for each tree, is exactly the same quantity that was said to be procured at *Madhu-giri*. Nothing is paid to the *amildar* for the plantains or other fruit; but on this account, the custom-house, according to the size of the garden, charges annually from three to five fanams. Where the capily is used, the rent for each tree is rather under a penny. When the reservoir supplies the water, it is rather above two pence. Even in this case, when the trees are at sixteen cubits' distance, the rent of an acre does not exceed twenty shillings; which is less than rice would give, and not a third part of what is paid for the same quantity of ground at *Madhu-giri.* On the same produce, the rent is rather greater here, so much superior at the former place is the skill of the cultivator. The areca-tree is never cut till its leaves have turned brown. Its stem has then acquired great hardness, and in building cottages is very useful.

"The monkies and squirrels are very destructive, but it is reckoned criminal to kill either of them. They are under the immediate protection of the *Dáséris,* who assemble round any person guilty of this offence, and allow him no rest until he bestows on the animal a funeral that will cost from one hundred to two hundred fanams, according to the number of *Dáséris* that have assembled. The proprietors of the gardens used formerly to hire a particular class of men who took these animals in nets, and then by stealth conveyed them into the gardens of some distant village; but, as the people there had recourse to the same means, all parties have become tired of this practice. If any person freed the poor people by killing these mischievous vermin, they would think themselves bound in decency to make a clamour; but inwardly, they would be very well pleased; and the government might do it, by hiring men whose consciences would not suffer by the action, and who might be paid by a small tax on the proprietors.

"The *Marattah* invasion has ruined one half of the gardens; the trees having been cut for the cabbage, which is composed of the young leaves collected, at the summit of the tree, in a large bud. New gardens are now planting without advances from government. Many of the old proprietors having been reduced to poverty, have sold their right of replanting to others, who were in better circumstances; for all palm-gardens become private property, and may be sold or mortgaged, which, in the *raja's* dominions, is not the case with any land that is cultivated for grain.

The proprietors complain that for old trees they are obliged to pay the same rent as for young ones. An old garden thus becomes much more valuable to the government, as on the acre there will be more trees that pay rent."

XLVII.—*On the advantageous employment of Asses as a motive power to actuate Machinery.* *By the* EDITOR.

THE Editor first saw these animals employed instead of men, horses, or a steam-engine, to work the large bellows used to excite the fires in the cupola furnaces, at an iron-foundry in Southwark, several years since, and with great satisfaction to their owners, and comparative ease to themselves.

On mentioning this circumstance to an intelligent friend a few days since, he said, a similar application had been made of them to actuate the machinery used in an extensive soda-water manufactory, for many years past, by the patentee of several very important improvements in that article; and who, happening to come in just at the time, confirmed what had been stated, and likewise afforded the Editor much valuable information on the subject. He said, that he was greatly shocked at seeing the painful exertions made by the four labourers employed in his manufactory to work the pumps and the vibratory agitating machines, in which the carbonic acid was mixed with the water, and thought of procuring a small steam-engine as a substitute for human power; but reflecting that even a small steam-engine would require the same attention of an engineer as a larger one would, he endeavoured to find a substitute for it, and fortunately heard that at an extensive white lead manufactory at Chelsea, asses were used to drive the colour-mills with the greatest success. The proprietors of this work, on his applying to them, kindly afforded him every necessary information upon the subject, and finally induced him to employ these patient and hardy animals himself.

He had a set of eight asses, four of them working at a time, and the other four ready to relieve them in their turn. The circular walk in which they moved was only *thirteen feet* in diameter, being considerably less than that usually necessary where horses are employed, and consequently occupying less room, a very desirable circumstance in many cases. Upon the upright axis four beams were affixed, to which the animals were yoked as usual; and also a cast-iron bevel or mitre-wheel, six feet in diameter, which drove a bevel pinion of one foot, affixed upon a horizontal shaft, which also carried a drum of four feet in diameter, from which a broad leather band was passed over another band-wheel or drum of two feet in diameter, fixed upon another horizontal shaft (which, however, was introduced chiefly for the convenience of applying the motive power the more readily to the machines as they were already fixed), and from this latter drum other bands were passed to the riggers or band-wheels, of one foot in diameter, which were mounted upon the crank-axes. A fly-wheel, to afford momentum, and to equalize the irregular motions of the pumps, was also employed. In this mode, and without urging the pace of the asses beyond their ordinary walk, he obtained the necessary velocity to actuate his machines with the greatest success; the animals were placed in far better circumstances than they usually experience here, and did their work with comparative ease to themselves. They had a proper stable provided for them, and food equal to their wants, which, however, was far less costly than that required for horses, being merely chaff, cut straw, and hay, corn being a luxury they never required. He reckoned the power of each ass as being quite equal to that of a man; but whilst the latter required from seventeen shillings to five and twenty in weekly wages, the former was kept a week on *nine shillings only*, a great difference indeed!

When we consider the trifling cost of each animal, and the cheapness of their food, we cannot but think that their labours might be profitably employed on many occasions to actuate machinery, and particularly in this metropolis.

The machinery or mill-work was but of an ordinary construction, being executed in a cheap but satisfactory manner by an agricultural implement maker; and the use of *leather bands*, in preference to the *toothed wheel-work*, was a great improvement; indeed, the toothed wheel-work might have been entirely superseded, as a broad leather band might have been passed from a vertical drum, affixed upon the upright shaft, to another drum upon the horizontal shaft, and *crossing* in its way, would have thus converted the vertical movement into a horizontal one with great facility; at most, guide-pulleys would only have been required.

In the case of corn-mills, the motion might be thus communicated, by means of broad leather bands and band-wheels, to the mill-stones with very great ease, as there is no occasion here for changing the direction of the motion, as in the former instance.

XLVIII.—*On the Indian methods of Irrigating Land, from Reservoirs, in the culture of the Cocoa-Nut and Betle-Palms, Betle-Leaf, and Sugar-Cane.*

WITH A PLATE.

In our last number we gave a description from Buchanan's "Journey from Madras, through the Countries of Mysore, Canara, and Malabar," of the dams and sluices of the *Saymbrumbacum* tank, near Madras; we now give a figure of it, from which its construction will be better understood.

Fig. 1, plate VII. is a section of the dam, weir, and sluice; *a* is the dam, confining the water in the reservoir to its greatest height; in case of a sudden rise, however, taking place, and which might endanger the safety of the dam, and, consequently, of the villages below it, provision has been made to allow it to escape by the several weirs or *codies*, constructed along the dam at intervals. *b* is a section through one of them, the interior face of it, next to the reservoir, as well as its exterior one, being strongly fortified, by large stones placed in a sloping direction, so that the water may rush over it, without undermining the bank, or dam. *c* is one of several pillars of stone let into the top of the weir, against the insides of which, next the reservoir, sticks, straw, and mud are laid temporarily, so as to be instantly removed on the approach of danger, and allow the water in the reservoir to flow off to the level of the top of the weir, as indicated by the dotted line. *d d* is the sluice through which the water is let out for the purposes of irrigation, when the conical valve *e* is raised up from its seat in the flat stone laid upon the inner end of the sluice, by means of the bamboo staff *f* affixed to it. The water rises through the well *g*, and is conveyed to its destination by means of a canal communicating with the well.

Fig. 2, represents part of a betle-leaf garden, which is thus managed in order to irrigate it:—" In March or May, the whole ground is to be trenched one cubit deep, and surrounded with a mud wall, immediately within which a hedge of the *euphorbium tirucalli*, and of the *arundo tibialis*, must be planted. When there is not plenty of rain, this must for six months be regularly watered. Then dig the garden, and form it into proper beds, leaving a space of about twenty feet between them and the hedge. The sketch fig. 2 will assist the imagination in understanding the description of the beds. From the main channel (1) for conducting the water to the garden from the reservoir, draw others (2) at right angles, and distant twenty-two cubits. Between every two of these, to drain off the superfluous water, draw others (3, 3) about a cubit wide, and deeper than the former. The garden is thus divided into rows ten cubits in width, having on one side an elevated channel (2) for supplying it with water, and on the other side a deep canal (3) to carry off what is superfluous. These rows (4) are divided into beds, six cubits wide (5), by cuts made from the deep canals, and ending in *cul de sacs* (6), which carry off the water into their principals. Each of these beds is divided into two parts (7) by a narrow channel coming from those which bring the supply of water. Each division of a bed, therefore, has on one side a channel (8) to supply it with water, and on the other a canal (6) to carry off what is superfluous; and it is surrounded by a narrow bank, about six inches high (9), which excludes the water that flows through the channels; within these little banks the divisions of the beds are carefully levelled. In the centre of each division is then formed a row of small holes, distant from each other one cubit; and in January, in every hole are put two cuttings of the betle-leaf vine, each two cubits long. The middle of each cutting is pushed down, and slightly covered with earth; while the four ends project, and form an equal number of young plants, which for the first eighteen months are allowed to climb upon dry sticks, that are put into the ground for the purpose. For the first week after being planted, the shoots must be watered twice a day with pots; for another week once a day, and until the end of the second month, once in three days. A small drill is then made across each division of the beds, and between every two holes in each; and in these drills are planted rows of the seeds of the *agashy*, or *æschynomone grandiflora*, *nugay*, or *guilandina moringa*, and *varjepu*, or *erithrina indica*, E. M. The young betle plants must then have some dung, and for four months more must be watered with the pot once in three days. Afterwards, so long as the garden lasts, all the channels must once in four days be filled with water. This keeps the ground sufficiently moist, and water applied immediately to the plants is injurious.

Fig. 3 represents the manner of irrigating the fields of sugar-cane at *Madura*. "The preparation of the ground occupies about three months previous to the middle of March. The steps taken in this preparation are as follows.

Water the field, allow it three days to dry, then plough it six times, and break the clods. Manure with leaves, and plough again; manure with dung, and plough three times. The field having been thus prepared, is divided into beds. Four holes, about a cubit's distance from each other, are formed in the breadth of each bed. Two cuttings, of three joints each, are put into each hole, and covered first with an inch of earth, and then with five inches of dung. Water is then given to each hole, and every morning for fifteen days this is repeated. The holes are then dug up with a sharp stick, and more dung is given. For fifteen days more the watering must be again repeated. The whole field must then be hoed, and in each bed a winding channel must be formed, passing between the rows of holes, as in the explanatory sketch, fig. 3. When there is no rain, these channels must once a week be filled with water. At the end of a month, the ground must be again hoed, and the channels formed afresh. Between May and June, the canes become a cubit high. The plants of each hole must then be tied together with a binding of leaves. A third hoeing is now given, and the earth heaped up round the roots of the canes. The waterings once a week must be continued. When the plants have grown another cubit, which will be about the beginning of September, they must be tied a second time; and again a third time about the beginning of November, the watering once a week having been regularly continued. About the end of December the works for making the sugar are repaired; in the tenth month from planting, the crop commences, and must be finished in the eleventh. The cane is succeeded by *sesamum*, that by rice, and that again by sugar."

XLIX.—*On a new Musical Instrument, affording Tones similar to those produced by the Æolian Harp. By the* EDITOR.

WITH FIGURES.

We are favoured by a friend, who has introduced this instrument from the continent, with a sight of it, and have received his permission to make it public.

It consists of a metal plate, the size of that shewn in fig. 7 of plate VII., having four parallel holes or apertures made through it. Upon this plate another is rivetted, which is partly filed away very thin, and this thinned part is formed into four slender tongues, or springs, which exactly fit, but play loose within the four apertures in the other plate, when the two are combined as above-mentioned. Fig. 6 shews them so united; and fig. 8 is a section of the tongued part. Fig. 10, a plan of the block and tongues; and fig. 9 a section of the whole united.

The four thin lamina or tongues, firmly fixed at one end, lie even with the surface of the other plate, and play loose in the gaps made in it, as before-mentioned; and, upon placing the instrument within the mouth, and breathing or blowing through it, the lamina being placed next to the mouth, tones of great variety, and more or less loud or soft, and either concords or discords, may be produced, greatly resembling those afforded by the Æolian harp; but, of course, depending much on the skill of the performer.

In this instrument, like the Æolian harp, there is no possibility of governing the tones, so as to perform tunes; but its very wildness has a peculiar charm, resembling aerial music; and its great portability is another recommendation to it.

We do not recollect musical tones being produced in this manner in any other instrument; it may possibly lead to some useful applications in the construction of organ-pipes, the tones being frequently peculiarly soft and delicate; although it is capable, when forcibly blown through, of producing the most harsh and discordant ones.

L.—*On the Glass Furnaces used in India.*

WITH FIGURES.

We have described these furnaces in our last number, in our extracts from Dr. Buchanan's "Journey from Madras, through the Countries of Mysore, Canara, and Malabar," so that we have now merely to refer to the figures of them contained in plate VII.

Fig. 4 is a section of one of the three furnaces for making glass, which are usually constructed side by side, under a sort of terrace. *a* is the circular shelf or platform upon which the crucibles *b b*, containing the materials, are placed; it has a hole *c* in its centre, through which the heat and flame from the fuel placed in the cavity *d* below ascends; and another hole *e* in the middle of a flat stone, which serves as a cover to the opening in the crown of the arch of the furnace, through which the crucibles are introduced or withdrawn. The fuel is put into the furnace at the side cavity *f*.

Fig. 5 is a section of the furnace used in working the glass into shape. *g* is a circular cavity made in the floor of the workshop; *h* a flat and conical cover to the furnace, made of baked clay; *i i i* three of the four openings made around the cover; by one of these, the fuel is introduced, down an inclined plane *j*; and the three others are for the workmen to take out the glass by. *k k* are two of the three pots containing the glass, and which are supported upon as many earthen brackets *l l*.

LI.—*On the different Black Colours. By the late celebrated* William Lewis, *M.B. and F.R.S.*

(Concluded from page 215.)

The dyeing of Hats Black.—The instructions of M. Colbert direct hats to be first strongly galled, by boiling them a long time in a decoction of galls with a little logwood, that the dye may penetrate the better into their substance; after which, a proper quantity of vitriol and decoction of logwood, with a little verdigris, are added, and the hats continued in this mixture also for a considerable time. They are afterwards to be infused in a fresh liquor of logwood, galls, vitriol, and verdigris; and where the hats are of a great price, or of a hair which difficultly takes the dye, the same process is to be repeated a third time. For obtaining a colour of the utmost perfection, the hair or wool is ordered to be dyed blue previously to its being formed into hats. The present practice is more compendious, and affords, as we daily see, a very good black. The method of our hatters, as I have been informed, does not differ materially from that of the French, described in the *Encyclopedie*, which is as follows.

An hundred pounds of logwood, twelve pounds of gum, and six pounds of galls, are boiled in a proper quantity of water, for some hours; after which, about six pounds of verdigris, and ten of green vitriol, are added, and the liquor kept just simmering, or of a heat a little below boiling. Ten or twelve dozens of hats are immediately put in, each on its block, and kept down by cross-bars, for about an hour and a half; they are then taken out and aired, and the same number of others put in their room. The two sets of hats are thus dipped and aired alternately, eight times each; the liquor being refreshed each time with more of the ingredients, but in less quantity than at first.

This process affords a very good black on woollen and silk stuffs, as well as on hats, as we may see in the small pieces of both kinds which are sometimes dyed by the hatters. The workmen lay great stress upon the verdigris, and affirm that they cannot dye a hat without it; it were to be wished that the use of this ingredient was more common in the other branches of the black dye; for the hatter's dye, both on silk and woollen, is reckoned a finer black than what is commonly produced by the woollen or silk dyer.

Of the dyeing of Linen and Cotton Black.—The black vitriolic dye, though very durable on the substances hitherto mentioned, is perishable on linen and cotton. Pieces of linen and cotton cloth, and skeins of thread, boiled first with galls, and afterwards infused and dipped repeatedly in a decoction of logwood with vitriol, received a good black colour; but both the brownish stain which the galls communicate, and the blackness superinduced by the vitriol, were in great measure discharged by washing with soap; even the rusty colour which the vitriol of iron gives by itself, seeming in this way of application to be less fixed than if it had been employed without the galls. Steeping the linen for a month, previous to the dye, with galls, and with oak-bark, by which method fishing-nets receive from the astringents a pretty durable stain, was here of no service, the black dye proving equally perishable.

The dyers of thread follow a process somewhat different from the above. They first steep the thread in alum-water for several days, and then dip it repeatedly in the dyeing liquor, cold, or only lukewarm. The dyeing liquor consists of the irony and astringent matters mixed together; and in the room of, or along with, vitriol, they use either filings of iron, or the muddy matter, by some called *slip*, found in the troughs of grind-stones, where iron tools are ground. The woollen dyers are sometimes required to dye certain pieces of linen black, and in such cases they practise a method of the same kind; steeping the piece first in alum-water for two or three days, and then dying it in their mixed black liquor. By this means the colour is made to hold somewhat better; but how perishable it still is, we may see in all black thread.

As the stain produced by solutions of iron is very fixed on linen and cotton, and as the perishableness of the black dye seemed to be owing to the astringent matter of the galls not sufficiently penetrating or uniting with the vegetable fibre, and therefore, so easily coming off, and carrying the superinduced vitriol with it, I boiled pieces of linen and cotton, first in solution of vitriol, and afterwards with galls, hoping that the vitriol, fixing itself first in the cloth, would make the astringent matter applied upon it likewise fixed. But the event was otherwise; the colour did not prove so black as when the contrary method of application was followed, and the blackness was rather more destructible.

The colour of indigo and madder being very durable on linen, it was hoped that a ground of these might contribute to fix the black. I therefore made trial of sundry pieces of red and blue linen, dyeing them black by the methods already described. They appeared to have no advantage over those which had been dyed directly from white; the black was easily washed out, the blue pieces remaining nearly of their original colour, and the red ones a little darker than at first.

After many fruitless attempts with different solutions of iron and different intermedia, no probability of success appeared to remain, unless the vegetable substance could be changed as it were, or impregnated with an animal principle. Accordingly, I boiled linen and cotton, previous to the galling, with weak solutions of animal glues, but the success was no better than before.

In the fourth volume of the Memoirs of the correspondents of the French Academy of Sciences, M. l'Abbé Mazéas gives a curious dissertation on the red printed cottons of the East Indies; in which he describes a method, practised by the Indians, of impregnating their cotton with animal matter, in order to its receiving a red stain. A ley is made from the ashes of a certain kind of wood, and with this is mixed some sheep's dung, and a quantity of the oil of sesamum, in want of which oil they use hog's lard; these ingredients stirred together are said to unite into a milky liquid. The cotton is steeped in this liquor during the night, and exposed to the hottest sun during the day, for a fortnight. The author above-mentioned says he tried this process with the common expressed oils, without success; but that with hog's lard it succeeded perfectly.

On reading the Abbé Mazéas's paper, I immediately set about trying what effect a like preparation would have in regard to the black dye. Here a considerable difficulty occurred in making the mixture; for with a strong ley of wood-ashes, or with a solution of purified alkaline salt, the lard could not be made at all to unite by stirring, or even by boiling; the liquor acquired no milkiness, and the lard floated distinct on the surface; and, indeed, it was not expected that a perfect union of this ingredient could be procured without the use of the caustic ley of the soap-boilers, prepared with quicklime. The intention, however, being only to obtain a soap made with animal fat, and the common soft soap being such an one, I mixed soft soap and sheep's dung well together, three parts of the former to two of the latter, and diluted the mixture with warm water. Some pieces of linen and cotton cloth, and some skeins of linen thread, were steeped in this liquid every night, and hung out in the day time, not indeed in a hot sun, but in all that the month of December afforded. The subjects were then all dyed black, by the second of the processes described for woollen cloth, and some of the same kind unprepared, were put into the dye along with them. All the pieces being taken out and washed, the prepared ones appeared to hold their colour better than the unprepared, though not in such a degree as to make the process interesting to the workman. From this show of success, however, in an unfavourable season, the experiment seems worthy of being tried again in more advantageous circumstances.

We have seen that linen and cotton are stained of a lasting black colour by certain vegetable juices; and that these juices might probably be obtained in quantity, if not in our own country, yet in certain parts of the British dominions, some of the trees which afford them being natives of the American settlements. Till this branch of vegetable curation shall be established, the British artist can receive little benefit from knowing the materials with which the deep black stain on the Indian cottons is said to be fixed.

We have seen also, that a black colour, or a colour approaching to blackness, may be produced on woollen cloth, from a combination of two other dyes, viz., by applying a full madder-red upon a deep blue ground. Both the blue and the madder-red can be fixed upon linen as well as upon woollen; and accordingly I tried compounding them upon linen in different ways, sometimes applying the red upon the blue, and sometimes the blue upon the red. In several of these experiments, the linen, as it came out of the dye, appeared of a good black colour; but, on washing it, so much of the colour was discharged, that only a kind of dark purple remained.

Some printed linens and cottons have a durable black stain, which, as I am assured by a skilful and ingenious artist, is made with madder and a solution of iron. A quantity of iron is put into sour strong beer; and to promote the dissolution of the metal, the whole is occasionally well stirred, the liquor at times drawn off, the rust beaten from the iron, and the liquor poured on again; a length of time is required for making the impregnation perfect, the solution being reckoned unfit for use till it has stood at least a twelvemonth. This solution stains linen yellow, and of different shades of buff colour, and is the only known material by which these colours can be fixed on linen. The cloth stained deep with the iron liquor, being afterwards boiled with madder, without any other addition, becomes of the dark colour which we see on printed linens and cottons, which, if not a perfect black, has a very near resemblance to it. It is submitted to the consideration of those whom it may concern, whether this fixed colour would not be preferable on linen thread to the perishable black with which linen thread has hitherto been dyed. It is probable, that even a better black might thus be dyed on thread, than that which the printer on linen produces; for in this last business, while some parts of the linen are stained deep with the iron liquor, in order to their being made black, others are stained paler, with the same liquor diluted with water, for making purple; and others, designed to be red, are prepared with a solution of alum and sugar of lead (acetate of lead); all these colours are dyed in one and the same copper of madder, with a heat a little below boiling; a boiling heat would give the dark tawny, or blackish hue to the red, and therefore, in this process, must necessarily be avoided; but for the same reason, it would contribute to deepen the black, and therefore ought always to be called in aid where thread, or entire pieces of linen or cotton, are to be dyed of this colour.

The staining of Wood, Ivory, Stones, &c. Black.—The staining of wood black for picture frames, &c. depends on the same principle with the black dye. For a deep black, the wood is brushed over four or five times with a warm decoction of logwood, and afterwards suffered to dry thoroughly between the several applications of the liquors; thus prepared, it receives a fine deep black colour, from being washed over with a solution of vitriol; in the room of which, some use a solution of iron in vinegar, keeping the vinegar for this purpose upon a quantity of the filings of the metal, and pouring off a little as it is wanted. A pretty good black is obtained also more expeditiously, by brushing over the wood first with the logwood liquor, and afterwards with common ink.

Plumier, in his "*Art de Tournir,*" directs the wood to be previously washed twice, with the second parting water of the refiners *(aqua secunda forti, separatoria; eau forte seconde)*; by which I suppose he means, not *aqua fortis* itself, but the solution of copper in aqua fortis remaining after the silver has been precipitated. Washing with aqua fortis was found to prevent the production of any black colour on the application of vitriol and astringents, as indeed was expected, this acid liquor destroying the colour of ink already made; a saturated solution of copper in aqua fortis appeared to be of no immediate injury, but it appeared also to be of no advantage.

Ivory, bone, horn, and other solid parts of animals, may be stained black in the same manner as wood. They likewise receive a deep black stain from solution of silver, which should be diluted with water to such a degree as not sensibly to corrode the subject, and applied two or three times if necessary, at considerable intervals, the matter being exposed as much as possible to the sun, to hasten the appearance and deepening of the colour. *Hair* also, made perfectly clean, and moistened with the same solution, is changed from a red, grey, or other disagreeable colour, to a brown, or deep black; the liquids commonly sold under the name of hair-waters, are at bottom no more than solutions of silver diluted largely with water, with the addition, perhaps, of other ingredients, which contribute nothing to their efficacy. The solution should be fully saturated with the silver, that there may be no more acid in it than is necessary for holding the metal dissolved; and besides dilution with water, it will be proper to add a little rectified spirit of wine, for the further dulcification of the acid. It must be observed, that for diluting the solution, distilled water, or pure rain water, must always be used; the common spring waters turning it milky, and precipitating a part of the dissolved silver. It is to be observed also, that if the liquor touches the skin, it has the same effect thereon as on the matter to be stained, changing the part moistened with it to an indelible black.

Marble.—It is difficult to introduce into marble a true black colour. Solution of silver sinks deep into the stone, sometimes an inch or more; but the colour it communicates, at first reddish or purplish, deepens only to a brown. M. du Fay, in the Memoirs of the French Academy, for the years 1728 and 1732, gives two methods of staining marble of a blue colour, approaching more or less to black, according to its deepness, and not ill resembling those which are naturally found in some marbles: one is, with essential oil of thyme, digested in volatile spirit of sal ammoniac; the other, with tincture of archil. When the oil of thyme is digested with the volatile spirit, it becomes first yellow, then red, then violet, and at last of a deep blue. In six weeks' digestion, it had acquired a pale blue, and in this state gave little colour to marble: after standing for six months, it was deepened almost to a black blue, and being now applied on warm marble, gave the stain desired.

With regard to archil, a tincture of it in water is applied on cold marble, and renewed as it evaporates, till the colour is sufficiently deep. Though the colour of archil is very perishable on cloth, yet in marble it appears to be more durable. M. du Fay says he saw pieces of marble stained with it, which in two years were not sensibly changed. The colour, however, though made very deep, is far from being a true black, being rather a dark purplish blue.

The porous marbles, which admit water to sink into them, I have stained of a full black colour with common ink, either by applying on the warm marble an ink already made, or by the alternate application of astringent liquors and solutions of iron. With the more compact marbles, this did not succeed, though they were heated so far as to make the liquors boil upon them: in some parts the colouring matter scarcely penetrated at all; and where it did sink a little into the stone, it was so dilute, as to appear only purplish. The spirituous tinctures seemed to penetrate better than the watery infusions.

On marbles which would receive the inky matter, I tried the alternate application of solutions of lead and of sulphureous solutions, applying sometimes the one first, and sometimes the other; but could not find that they produced in the stone any degree of the black or dark colour which they do upon paper. By solution of copper, managed as at the end of the following process, and by a solution of the metallic part of cobalt in *aqua regia*, employed in the same manner, the most compact pieces were stained black; though this process requires too great a heat to be practised on marble without danger of injuring the stone. The colour which solutions of gold communicate to marble in its deep shades, obtained by repeated applications of the solution, approaches very near to black.

Agate, &c.—Several of the hard stones which strike fire with steel, receive a dark stain, inclining to black, from solution of silver. M. du Fay relates, in the French Memoirs for 1728, that to chalcedony, this solution gave a reddish-brown colour; to oriental agate, a blacker stain; to an agate spotted with yellow, a purple; to the jade-stone, a pale brown; to the common emerald, an opaque black; to the white parts of the common granite, a violet, equally deep; to serpentine stone, an olive colour; while the much softer slates, talcs, and amianthus, received from it no colour at all. Former experiments made by me afford room to suspect that the solution of silver stains stones only in virtue of their containing a calcareous earth, or such an earth as the acid is capable of dissolving: if this be the case, there is little wonder that some of the hard stones should be stained, and some of the softer ones be unaffected by it.

Among the hard stones that have been tried, the agates seem to be those which are acted upon most readily; they are also those which have oftenest been attempted to be stained. The solution should be made in strong aqua fortis, or spirit of nitre (nitric acid), and be fully saturated with the metal. The stone, after the fluid is applied, should be exposed to the sun for two days or more; and if, when dry, it be removed into a moist place, and afterwards exposed again to the sun, the production of the colour will be the more speedy. After the stone has acquired the full colour which the first quantity of the solution can communicate, it may be moistened with more, and this repeated two or three times, by which the colour will be deepened, and made to penetrate further. M. du Fay found that an agate, about a sixth of an inch in thickness, by applying the solution on both sides, may be stained throughout its whole substance. The tincture, however, is rarely uniform on these or other stones; most of them having veins, which, though undiscernible in the natural stone, are in this process made apparent, being more easily or more difficultly penetrable than the rest of the mass, and sometimes forming not inelegant varieties in the stained stone.

M. du Fay observes, that though stones may without much difficulty be stained by solution of silver, yet it is scarcely possible to form very neat designs on them, on account of the spreading of the liquid; and that this imperfection appears to be the less, according as the solution is the more saturated, so as to dry or crystallize the more speedily. An easy method of obviating this inconvenience is suggested by the practice of the engraver; for the means by which he confines the aqua fortis on his copper-plates to the minutest strokes, would doubtless answer the same intention here. The surface of the stone being coated with a proper tenacious substance which the acid cannot act upon, as the composition called etching-wax, which consists of resinous substances melted with wax, or boiled with oil to a due consistence, and the drawing being made through this ground, so that each stroke may reach down to the stone, it may be presumed, that the solution of silver, afterwards applied, will no where spread further than the parts thus laid bare.

The stones thus coloured by art, differ from the natural, in two remarkable properties of the colouring matter. The natural stones resist moderate heat, by which the artificial are in great part destroyed. The natural stones, steeped for several hours in aqua fortis, suffer no apparent change; whilst those, which have been coloured by art, almost entirely lose their colour. It is observable that the colour destroyed by aqua fortis is restored again by exposing the stone to the sun; but that the colour destroyed by fire, cannot be recovered without a fresh application of the colouring solution.

There is another method of staining stones, of a colour more truly black than that which the solution of silver communicates to most of them, and with this further difference, that the colour being produced by fire, I have not found that either fire or aqua fortis will destroy it. Pieces of different stones, marbles, pebbles, flint, &c., were washed over with a saturated solution of copper made in aqua fortis; when dry, they were put into a crucible, and kept for a little time in a fire, just sufficient to make the vessel almost red hot. All of them were stained in the parts which had been moistened with the solution, of a black colour, durable, and pretty deep, though it had penetrated only a very little way into the substance of the stones.

When the smooth surface of an agate, or other stone not dissolvable in aqua fortis, is moistened with the copper solution, if a small iron nail be set upright on its head in the middle of it, the iron absorbs the acid from the copper, and the copper now separating from the fluid, shoots into fine ramifications, like the branches of trees or shrubs, generally of a very elegant appearance. If the nail be then removed, and the corroded iron carefully washed off, by dipping the stone into water, the vegetations may be changed by heat to the same black colour as the simple solutions of copper, in the foregoing experiments, so as greatly to resemble the figures naturally found in certain stones, as that called the Mocho-stone. The colour is not indeed fixed in the stone, like that resulting from the solution of copper alone; but a plate of crystal laid over it in the manner of a doublet, conceals this imperfection. The only difficulty in this operation consists in the washing, in which great dexterity is requisite, to separate the corroded iron, which would give a rusty stain, without washing off or disordering the fine vegetation of the copper.

Black Glass and Enamel.—There is a species of blackness, as we have formerly seen, which results in certain circumstances, from the simple deepness or concentration of other colours. Thus many vegetable juices and infusions, yellow, reddish, blue, &c. on being evaporated to the thick consistence of an extract, look black; and these black masses, when spread thin, or diluted with water, exhibit again the original colours of the liquors. Something of the same kind seems to happen in glass and enamel. Smalt or zaffre, which in a certain proportion give a blue colour to vitreous bodies, if employed in a larger quantity, make them black. Manganese, which in a small quantity, gives a purplish tinge, in a large one gives a black. Preparations of iron, whose colour in glass, in a dilute state, is sometimes yellow, and sometimes greenish or bluish, are always of a dark brown or black, when the glass is overdosed with them; hence many of the ferruginous earths and stones melt into a black glass, as the coloured clays, several slates, and the stone called whynn-stone, with which some of the streets of London have been paved. Black glasses, or enamels, made on this principle have, however, like the concentrated vegetable liquids, one imperfection; that though of a deep black colour, when in masses of any considerable thickness, yet when spread thin they always betray some of the original colour, or of the particular hue, which they would have if the colouring matter was in less quantity. The most perfect black is obtained by adding a mixture of two or more of the above darkening materials: instead of taking colourless glass or enamel for the basis, it will be of advantage to use fragments of different coloured pieces; and compositions which have been spoiled in trying to tinge them of other colours, answer as well for this purpose as any.

The common black glass, of which beads are made for necklaces, &c. is coloured, as I am informed, with manganese only; hence, when powdered, it looks of a dirty purple colour. The manganese, perhaps, increases the fusibility of the glass, for an ingenious friend observes, that in making impressions in different kinds of glass, he has found this black sort to be by far the most fusible of any. That there is a strong action between the manganese and the glass may be presumed from the great effervescence which happens on melting them together. One part of manganese is sufficient to give a black colour to near twenty of glass.

The enamellers require a black more perfect than that which manganese alone can produce; and employ, as I am informed by an experienced artist, a mixture of manganese, zaffre, and scales of iron. These ingredients may be mixed together in equal quantities, and one part of the mixture be added to, and melted with, fifteen or twenty of the usual bases of enamels.

LII.—*On Improvements in Gas Lighting. By the* EDITOR.

WE are glad to find that Mr. Reuben Phillips's improved mode of purifying coal gas is getting into use; he effects it by passing the gas from the retorts through a number of beds or thin layers of lime placed upon sieves laid one upon another, the lime having been previously brought to such a state, by adding more water to the hydrate of lime in powder, that it is found to adhere together, on grasping a handful of it, and can thus be spread over the sieves, leaving interstices between the coherent parts, sufficient to afford a free passage to the gas through the different layers contained in the sieves. The sieves are heaped upon one another to the number of perhaps ten or twelve, each sieve having a water-joint around it, into which a rim, descending from the one above it, enters, and thus renders the joinings gas-tight. The gas, after passing only once through the lime in a pile of these sieves, is found to be sufficiently purified, and, indeed, is in danger of losing a portion of its illuminating power from being over purified. We have seen the lime after having thus performed its office, thrown out of the sieves, in the form of spherical masses, coloured yellow, green, pink, &c. and heating, and giving out steam, arising from the ammonia in the lime combining with the water in the air. This lime is found to be capable of making a good mortar, with the addition of an equal quantity of fresh lime.

By this method, the labour of turning the agitators, which are necessary in using the cream of lime to purify the gas as usual, is entirely saved; and the great nuisance arising from the stench of the impure cream of lime, removed from the washers, mixed with sulphuretted hydrogen, ammonia, &c. is completely obviated.

In those establishments, however, where the gas-washing apparatus is employed, great improvements in the use of it may be made, by adopting the judicious system introduced by G. Lowe, Esq., in the chartered company's gas works, in Brick-lane, Old-street. Instead of suffering the above nuisance to continue, as was the case previous to his undertaking the superintendance of the works, he now evaporates the impure cream of lime, to the consistence of a thick mud, by putting it into cisterns, formed in the ash-pits of the retort ovens; and thus he not only increases the effect of the fuel contained in the ovens, by passing the steam from the evaporating water through them, but he finds that the cast-iron furnace bars will last a much longer time than before he adopted this plan. When the mud is thus formed, he spreads it over the tops of the retort ovens, and completes the drying of the lime. In this state it becomes so caustic, that the workmen who employ it in luting the mouths of the retorts, are obliged to wear gloves in order to protect their hands from the effects of its corroding action upon the skin.

Mr. Lowe showed the Editor lately, the mode he has also adopted of converting the coal-tar made in the Brick-lane works (which has accumulated in the Peter-street gas works to an enormous extent) into fuel, whereby to assist in heating the retorts. He causes the tar to descend through a hole made in the tar main above, in a thin stream, into a funnel, fixed into the top of a bent iron pipe, which passes into the retort oven, through a small hole made in its front; here it is delivered upon the red hot coals contained in the furnace, and is instantly converted into a bright flame, by which the retorts are uniformly heated from end to end in the most complete manner. Here again he has converted a nuisance into an advantage.

In the new retort-house, erected at the Brick-lane works, under the superintendance of Mr. Lowe, he has greatly increased the comfort of the labourers employed in charging and emptying the retorts, by having only one row of ovens erected therein, and ventilating the house, by forming in the wall, opposite to the fronts of them, windows or other openings. The workmen thus, instead of being placed between two fires, as is the case in the retort-houses, as usually constructed, here perform their laborious duties in comparative ease.

An intelligent friend informed us recently, that in the gas works at Ghent, in Flanders, where, in consequence of the high price of coals, they were obliged to extract gas from resin, and had adopted Mr. Daniel's process for that purpose, the retorts were destroyed in so short a time, that the expences of rcplacing them would have been enormous. In this predicament, and after frequent complaints had been made to him, Mr. Daniel resolved upon taking Mr. Lowe with him to Ghent, where they found the fact to be as represented. On investigating the cause of this evil, Mr. Lowe found that the retorts were destroyed not so much by the action of the fire upon them, as by the corrosion of the *pyroligneous acid*, extracted from the resin, in converting it into gas. Mr. Lowe provided a remedy for this mischief, in the employment of lime to neutralize the acid.

The same friend also mentioned, that he had seen at the workshops of a manufacturer of gas lanterns, in London, the head of several which had been corroded so nearly through, by the action of the sulphuric acid and water upon them, which is extricated in the combustion of the ordinary coal gas, that the finger could be passed through them with the greatest ease; and this effect had been produced in a very short space of time. The Editor, on calling upon the manufacturer to ascertain the fact, found it to be as stated; the iron being converted into rust, and nothing left but the outward coat of tin, and the paint with which it had been covered.

The foreman stated that this was a very common occurrence, and was entirely caused by the maker of the lanterns neglecting to paint the *inside* as well as the *outside* of the covers with oil-paint; and which his employer constantly made it a point of doing, not only on first sending them out of his manufactory, but he also periodically renewed the painting afterwards; and that in this way, and by this cheap and simple expedient, the lanterns were made to endure for a considerable length of time.

LIII.—*On the Advantages of employing Charcoal to Light Fires. By the* EDITOR.

IN the domestic use of the anthracite, or blind coal, in the United States of North America, they have found it expedient, as we have formerly stated, to employ charcoal to kindle it; in like manner we conceive it would be equally desirable to use it in the combustion of gas-coke, as this, like the anthracite, is equally destitute of bitumen.

The chymist and the metallurgist are well acquainted with the value of charcoal for the purpose of lighting their fires; but it yet remains to point out its very superior advantages over that most extravagantly expensive article of domestic economy, fire-wood, in domestic life.

When a fire is already kindled, in order to light another fire with charcoal, we have only to lay three or four pieces of it between the bars of the grate; and having then laid a few bits of fresh coal upon the bottom of the grate in which the second fire is to be made, to lay the kindled pieces of charcoal upon them, only taking care that the ignited parts be placed in juxta-position. These may then be covered either with embers or with pieces of fresh pit coal, and upon directing the blast of the common hand bellows upon them, the heat of the charcoal will be immediately greatly excited, and the more vehemently we blow, the more vividly will the charcoal burn, and instantly communicating fire to the fresh coal, the flame from that will farther aid the combustion of the charcoal, and a brisk fire be presently made. On the contrary, in lighting a fire by the help of the ordinary fire-wood, we must patiently wait a considerable time before venturing to blow it, unless we would either extinguish it or blow it entirely out of the grate.

In the case, indeed, of there being no fire previously lighted, we must ignite the pieces of charcoal by directing the flame of a lamp or candle upon them with the blowpipe, and then proceed as above directed. Here the small *pumice-stone furnace* of our invention, and which was described by us in the first volume of the *Technical Repository*, will be found of great use, both to contain the charcoal whilst directing the flame of the lamp or candle upon it to kindle it, and more particularly in afterwards exciting it with the bellows.

We hope to be excused for this detail upon so trite a subject as kindling a domestic fire; but to the student, who ought to render himself independent of any other help at all times, and the more particularly when he wishes to enjoy the great benefits arising from early rising, in the pursuit of any important employment; that information, by the adopting of which he can quickly secure to himself the comforts to be derived from a cheerful fire in a cold morning, will be duly appreciated; and should he also, from this practice, acquire a facility in the use of that invaluable instrument, the blow-pipe, it will be of immense value to him on many other occasions.

With regard to obtaining a light, we are obliged to state, that after all that has been done, the German and French practice of striking fire with the flint and steel, upon a piece of amadou, or German tinder, laid upon the flint, near to its edge, is most to be relied upon. There is no trusting to the strength of the sulphuric acid contained in the fire bottles commonly sold, as it is continually attracting moisture from the air, owing to the imperfect manner of closing the bottles; and when we wish to employ it after standing awhile, it most commonly fails to ignite the chemical matches. With respect to the obtaining fire with the fire-tube, acting by compressed air, although we have provided ourselves with one of the best of them, yet we have either found the piston to have become hardened by cold, or stiffened by the thickening of the oil with which it is lubricated, and made air-tight, so as to fail us in the time of need. It is, therefore, well worth while to acquire a facility in procuring fire and light in the manner above indicated, with the flint and steel and German tinder, now so commonly employed here by those who are in the habit of smoking cigars.

LIV.—*On an effectual cure for Smoky Chimnies. By. Mr.* S. MORDAN.

MR. MORDAN, the patentee of the ever-pointed pencils, showed the Editor lately his contrivance for preventing his kitchen chimney from smoking, and also for quickly exciting his fire, without the aid of bellows.

His fire-place, like many others, had a wide open chimney to it, and was continually annoying his family by smoking. He determined, therefore, to contract the throat of his chimney in the following judicious manner:—He caused the entire opening at the bottom or throat of the chimney to be closed up, with the exception of an upright flue, just above the top of the grate, about a foot wide and high, and which led into the chimney. To the face of this flue he applied a square flat frame of wrought-iron, having upright grooves made on each side of it, in which a sort of hood, made of sheet-iron, could slide up and down. This hood is open behind, and projects about a foot square in front of the chimney back, over the fire-place or grate, and is sloped off at its top, towards the back of the chimney, and it has a handle in the front of it to raise and lower it by.

When the hood is elevated, it serves to guide the smoke and heated air into the upright opening leading into the chimney, its sides being closed to fit the upright back of the fire-place; and the fire then burns in the usual manner, but the chimney never smokes. When, however, he wishes to excite the fire at any time, he lowers the hood until its bottom nearly reaches down to the tops of the cheeks, or two keepers of the grate, and the fire, by the draught thus caused, instantly revives. In addition to this hood, he likewise occasionally hangs upon ledges, formed upon each side of it, an appendage made of sheet iron, which lengthens it so that its sides fit close upon the tops of the keepers, and thus the air can only gain access to the fire through the front and bottom bars of the grate, and then, indeed, the fire burns most vehemently.

LV.—*On the application of Human Labour to working Pumps in drawing the water out of the Thames Tunnel, instead of the Steam Engine.*

We have, in an article forming another part of the present number, recommended the employment of *asses*, to spare the *human labourers*, as motive powers, to actuate machinery. However, from the following notice contained in the *Observer* newspaper of Sunday, the 20th ult., it would seem, that others are possessed of different feelings. The following is a copy of this curious announcement.

"*The Thames Tunnel.*—The influx of water that has recently taken place, may be considered as only leakage. The pumps, when employed, always kept it two feet within the hour under head. It may be now considered as quite rectified, for on the gradual working of the steam-engine, at twenty-five strokes within the minute, the pumps reduced the water within the shaft to the depth above mentioned. Yesterday, so far had the water been exhausted, that its level sunk three feet below the crown of the passages, and so unimportant has the accident appeared, that it was only thought necessary to occasionally bring the pumps into play. A quantity of new machinery, prepared by Mr. Maudslay, is, we understand, about being set up, the design of which is to substitute, in part, *manual labour* for that of mechanical. It is to be applied, as we have heard, to the pumping, and the principle on which it is to be worked is that of a capstan, in which twelve horizontal bars are to be inserted, on which will be employed the labour of eight men each, making in the aggregate ninety-six! This is only intended in the event of any possible failure in the steam-engine to be made use of. The bags of clay and other materials are still throwing down on the northern bank, on which side the only danger was apparent."

Now Mr. Maudslay had not far to seek for an example of this very arrangement. In the new *Bedlam hospital* close to him, it has existed for several years, and is employed to work three pumps, which raise water from a well to the top of the building, and when the cistern there is full, it runs down again. This was done, not only for the service of the hospital, but likewise to afford the *insane patients* exercise in the open air, a very excellent and praiseworthy employment for *them* certainly; but we cannot advocate it in the case of other persons.

We are sorry to learn that there will most likely be full employment in this *slavish drudgery* at the Tunnel works, as the metallic pistons, made by Mr. John Barton, and which have hitherto been employed in the pumps, and done their work so ably with but little expenditure of fuel in the steam-engine, are now removed to make way for others; and the result has been, as we are credibly informed, that double the quantity of fuel at least has been required to work the pumps since.

LVI.—*On the improved Carriage Axletrees and Boxes, made by Mr.* William Mason, *of Margaret-Street, Cavendish-Square, London.*

We have given an account of Mr. Mason's patented improvements upon the carriage axletrees and boxes, usually termed Collinge's patent, in vol. X. of the *Technical Repository,* page 243; and also the specification of another patent taken out by him for his improvements in the construction of those axletrees and boxes for carriages, which are usually known by the names of *mail* axletrees and boxes, in vol. XI. of that work, page 193, and to which volumes we must refer our readers for the particulars of those improvements.

We have now to state, that he has lately employed his mechanical skill in the perfecting of the *common* axletrees and boxes for carriages of all descriptions. The arms being made truly cylindrical from end to end, well polished, and accurately fitted with his improved cylindrical patent cast-iron boxes, with four longitudinal grooves inside of them, for containing grease, which, continually circulating around the arms, lubricates them most completely; and both the arms and the boxes being made as hard as possible, they will run for several hundred miles without requiring to be taken asunder, or to be fresh greased; and indeed whenever that operation becomes necessary, any coachman is capable of managing them as readily as the ordinary ones.

There is also a new provision made for letting the wheels out, when necessary, in bad roads; this is effected by forming an upright elongated hole through the screwed ends of the arms; and making the screwed nuts either six or eight square, there are holes made through each square, for the linch-pin to pass through both the nut and the arm; so that each thread or turn of the screw is thus subdivided into six or eight equal parts, by which means the wheels can be let out and secured with greater nicety than usual.

These valuable improvements are nevertheless not productive of any additional expence, as the new axletrees and boxes are afforded at the same prices as the ordinary case-hardened axletrees with wrought-iron boxes.

We believe these decided and unexpensive improvements cannot fail to render the use of these new axletrees and boxes general; and they must greatly conduce to the ease and safety of all persons travelling in the carriages, stage-coaches, gigs, or other vehicles, fitted up with them, not only in this country, but on the continent especially, where *simplicity* must be combined with *utility*, to cause any new improvements to be adopted.

LVII.—*On the very superior Melting-Pots made by Mr.* WILLIAM MASON, *Patent Axle-tree Maker, London.*

IN general it is deemed quite sufficient for a melting-pot to endure a single day's work. Mr. Mason's, however, regularly serve *two days;* and he exhibited one lately, before the Committee of Chemistry, in the Society for the Encouragement of Arts, &c. Adelphi, which had endured *two days and one night in constant work,* and would no doubt have served five or six times more, had the founder been able to have persevered in his labours; but the constant and unremitted fatigue he had endured in the experiment, quite overcame him. This pot held seventy pounds of cast-iron at a time, and it lasted for *twenty-three meltings,* thus serving to cast upwards of *sixteen hundred pounds of iron!*

In casting copper or gun metal, *a pot regularly lasts him a week;* the heat requisite for fusing these metals being less than that necessary for melting cast-iron.

It would be improper to do more at this time, than to announce these facts; but the public may hereafter be put into possession of his very superior process for making melting-pots, as it is his intention, we believe, to compete next session for the premium offered by that society for improved melting-pots.

Before he began to make his own melting-pots, he continually experienced the evils arising from employing those usually sold, such as the loss of metal, fuel, and time, arising from their frequent failure; all of which evils he has, by his perseverance, now effectually overcome.

We shall esteem the communication of his very superior process for making melting-pots an important benefit, the employment of melting-pots being so exceedingly general, in a great variety of manufactures. In fact, his pots first begin to fail at their brims, owing to the sand and oxide from the cast-iron pigs falling upon them, and effecting a partial vitrification of their substance.

It must be evident, however, that these beneficial results could not possibly be obtained, were not his wind-furnaces also constructed upon a superior plan; and indeed, his core-moulds, and the whole arrangement and economy of his foundry for his patent cast-iron boxes for wheel carriages, are excellent; so also are his lathes and tools for boring them, and turning his patent axle-trees; and in this manner he is enabled to manufacture, even in London, where labour and fuel are so dear, excellent articles, and at moderate prices.

LVIII.—*On a mode of Conducting the Transportation on Rail-ways, and arranging the passing places, so as to avoid the necessity of a double set of Tracks.**

A CONSIDERATION of great importance in forming a railway, is the provision which must be made for carriages, moving in opposite directions, to pass each other. In canals no provision of this kind is required, as a canal must necessarily, to insure the banks from being washed away by the disturbance of the water, and to bring the resistance to the traction within proper limits, be sufficiently wide to permit two boats to pass abreast every where upon the levels.

With a railway, on the contrary, each carriage occupies the whole one set of tracks, and to enable another carriage to pass it, resort must be had to another set of tracks. These may be formed through the whole course of the line, or through parts of the line, at short intervals; the carriages passing from one branch to the other by turning platforms or other contrivances, which it is not now my purpose to examine. It may be observed, however, that no mode of forming these, that is, of uniting the branches to the main tracks, has yet been devised, not manifestly liable to derangement, so as in some degree to endanger the safety of the carriages. This, together with their cost, has prevented judicious engineers from recommending them to be placed nearer than one quarter of a mile from each other. Hence if long railways, such as are already projected in various parts of our country, to answer the general purposes of transportation, be made to consist of single sets of tracks, with passing places at intervals only, it must be evident that if the transportation be conducted in the usual method, it must be constantly interrupted by the carriages meeting at the intervals between the passing places.

To form an idea of the delays and vexations which would arise on a railway of this kind, for the transportation between a great agricultural district and the sea coast, let us suppose one of our great roads to be walled up on both sides, leaving merely width of way for a single carriage between the walls, except at intervals of a quarter of a mile; at which points only, a sufficient width should be provided for carriages to pass each other. Would a person enter between these straight walls with any confidence that he should arrive at the passing place without meeting some other carriage, and being obliged to return himself, or compel the other carriage to retreat before him, to the next passing place? The question is answered almost instinctively. Yet the difficulty of passing in opposite directions, on such a road, would be no greater than that to which carriages would be subjected on a railway constructed in the manner above described. A carriage on a railway can no more leave its proper tracks, than it can pass through a wall of iron. The cases, so far as passing is concerned, are precisely similar.

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* From the *Franklin Journal.*

Mr. Tredgold has shown that it can never be expedient to form a railway unless there be an assurance of 100 tons to pass over it every day, as the transportation of a less quantity than this, taking the interest on the cost of the railway as fairly chargeable to the expense of transportation, can be performed for about the same price on common roads. To enable the proprietors of a railway, therefore, to fix the tolls at so low a rate that the public may derive a clear and decided benefit from its formation, will require a transportation of 200 tons a day, on the average of the year. But as this would be constantly fluctuating, it must sometimes happen that, in the busy seasons, it would be necessary to carry 500 or 600 tons a day. To carry 500 tons would require about 72 horses, allowing seven tons to a horse, besides the weight of the carriages. As these would be divided equally in two directions, let us suppose 36 horses, with their trains of waggons, to pass in one direction, at unequal intervals, any given point on a railway in 24 hours. A carriage moving at the same velocity in an opposite direction, must meet them in 12 hours; and this meeting, if the distances of the trains from each other were determined altogether by chance, would be at an average of 1-8th of a mile from a passing place; taking the passing places to be 1-4th of a mile asunder. Then the velocity of carriages, loaded thus heavily, being three miles an hour, the delay at each meeting for the approaching carriage to arrive at the passing place, must be 2 1-2 minutes; and as the obligation to wait would fall indiscriminately on carriages in either direction, it is a fair presumption that the single carriage, which I suppose to be passing in an opposite direction to the 36 other trains, will be obliged to wait 18 times in the 36 meetings. The delay, therefore, from this cause would be 45 minutes. It would likewise require at least a minute on an average, to clear and arrange the turning branches at each of the meetings, making a total delay of about one hour and 21 minutes in a distance which would otherwise have been passed in 12 hours. The hindrance to a single carriage, or the train of carriages drawn by a single horse, as here stated, must clearly happen to every carriage passing at that time on the railway. Nor is this all, for the different velocities of the carriages, making it necessary for some to pass others, although going in the same direction, would be another fruitful source of confusion and delay. Great as this view of the circumstances of transportation on a single set of tracks shows the difficulties attending it, practice will be far from showing those difficulties to be less. Inded, when we add to the actual delay, the necessity which the carriers will be under to watch for each other, to send *avant couriers* to see that the next defile is passable (thus making it necessary to confine their journies to broad day light), it would seem that the vexations and delays that all this would occasion, must detract very much from the usefulness of this means of transportation.

To avoid the difficulties above stated, and various others, two entire sets of tracks have been provided to most of the larger railways of Great Britain. "They commonly make two sets of tracks," says Dupin, *Force commercial, tome* 1, p, 154, "side by side, one for the carriages to go, and the other for them to return;" and to show that this is thought by engineers a judicious and necessary practice, I may cite the following from the *Edinburgh Encyclopedia,* No. 31, p. 307. "In laying out a public railway, a breadth of not less than twenty feet should always be contemplated, so as to admit of two entire set of tracks, with the necessary sides, paths, and drains. In a private road with one set of tracks, a space of 12 feet in breadth may be found sufficient; but in this case it is generally necessary to make provision for four passing places in each mile. But this description of road should seldom be resorted to for a public railway, against which the inconvenience of the heavy drag at the turns of the passing places, and the frequent stoppage of the waggons, should prove sufficient objections."

But the formation of even a double set of tracks is not sufficient for a great railway, on which it is every way desirable to carry passengers as well as freight, to run coaches as well as waggons; the latter, from their heavier loads, going necessarily much slower than the former. The double tracks provide perfectly for the opposite directions, but from the greater velocity of the coaches, they will occasionally overtake, and must pass the waggons. Branches from one set of tracks to the other must be made for this purpose; and as these can only be at fixed points, the same interruption to the free passage of coaches, will, in a more limited degree, occur, that I have before enumerated as certain to happen on a single set of tracks, used by carriages passing in opposite directions. Taking the example of a railway of 100 miles in length, and supposing 36 trains of waggons to enter upon each set of tracks in a day, and to travel sixty-six miles and two-thirds, or three miles an hour, exclusive of stops to change horses, we have the equivalent of fifty-four such trains upon the whole course of such set of tracks at one time. The velocity of these trains of waggons being three miles an hour; a coach going nine mile an hour must pass thirty-six of these trains in the course of its route, or in twelve hours; allowing one hour for necessary stops. With passing places at each quarter of a mile, a coach would be obliged to check its speed to conform to that of the waggons thirty-six times a day, and to travel, upon an average, one eighth of a mile each time, at the rate of three miles an hour. This, if not an evil of such magnitude as that before stated, as inevitable to passing in opposite directions on a single set of tracks, must yet appear as a vexation which it would be exceedingly desirable to avoid.

I have been thus particular in stating the conditions under which transportation of all kinds, upon railways, is practised, for the purpose of proposing a mode of conducting it which does not appear to have been acted upon systematically in England, and which would seem to obviate the difficulties I have enumerated, without the cost of a double set of tracks, or even of passing places, except at distances of several miles.

The method I propose is to use a single set of tracks, and simply to confine the entrance of the carriages upon their routes, to certain fixed periods, and to prescribe to them certain velocities. By this means, the exact places of meeting could be determined, and proper provision made for passing.

Take an example of a railway one hundred miles long, and suppose that coaches, to travel nine miles an hour, and waggons to go three miles, enter upon their journies at both ends of the railway, after intervals of twelve hours only. The waggons in one direction would meet those of an opposite direction at the distances of sixteen and two-thirds, thirty-three and one-third, fifty, sixty-six and two-thirds, and eighty-three and a half miles, allowing always for necessary stops, from either end of the railway. The coaches would meet the opposite coaches midway, and they would meet trains of waggons at the distances of 25 and 75 miles from either end of the railway. The number of passing places, therefore, would be eight in one hundred miles, and if the velocities and times were accurately conformed to, each carriage would be subjected to a hindrance of eight minutes only, to clear and adjust the turning branches. There can be little doubt that the carriages could be made to arrive at the passing places within a minute of the fixed time. But as the passing places would fall at distances proper for changing horses, ten or fifteen miles might be allowed for a belated train to arrive. A longer time than this would, probably, rarely, if ever, be necessary, unless on the occurrence of some disaster to the railway, such as would interrupt the transportation, though conducted in any other way.

It must be necessary to any general railway, to form lateral branches, to pass through the country in various directions. Conformably to the system here proposed, the time of entering from these, upon the main track, should coincide with the arrival of the regular trains of carriages of similar velocity, at the junction of the branches with the main tracks. This arrangement would be very simple, and would, apparently, occasion neither confusion nor delay.

For the purpose of rendering the proposed method clearly understood, I have asumed certain numerical velocities and intervals between the periods of starting. But these would of course be made to suit the circumstances of the route. A third velocity between that of the coaches and waggons, might be assigned, should the public convenience require it. So also, on parts of the railway which would deviate much from a level, the passing places should be arranged in distance, to permit the descending carriages to travel with a greater velocity than the ascending.

The advantages of conducting transportation on a single set of tracks by this method, over that of suffering the carriages to pass at all times, and with all possible velocities, will, I think, be evident on a fair and careful examination. It is not, perhaps, too much to assume, that transportation could be conducted with as few vexations and hindrances by this method, on a single set of tracks, as it would be by a double set, letting the carriages enter at all times, considering the difficulties which would arise from the various velocities with which they would perform their journeys. Under this view the saving would nearly equal the cost of an entire set of tracks.

It may be assumed by some, that it would be a great convenience to travellers, to be able to commence their journies, and to traders to send their goods at all times. A little reflection will show this to be of very small moment. When we now undertake a journey, we find no difficulty in making our time of commencing it to conform to the period fixed for the starting of the coach or the steam-boat, and for sending goods, we could make our arrangements to conform in the same way without any inconvenience. It would, in truth, be a great advantage, peculiar to this system, that the loads of produce would arrive at the destined market at certain periods. This would enable the traders of all kinds to be in the market at the time to conclude their bargains at once, and be free to manage their other concerns. Amongst other incidental advantages of this method would be that of repairing the railway conveniently, and without interrupting the transportation; for as there would be long intervals of time when no carriages would pass any point requiring repairs, the rails could be taken up or any work performed which would, from its nature, render the railway impassable. Again, the drivers and attendants on the long train of carriages would thus be brought together, would, in case of accident, insure immediate assistance to repair any damage, or to remove a broken carriage from the railway if necessary to provide for the seasonable arrival of the rest.

D. T

LIX.—*On the French Method of Gilding upon Bronze, &c.* *By* M. D'ARCET.

(*Continued from page* 155.)

7th.—On giving the Colour of Or Moulu.—When it is desired to give to gilt articles the colour of *or moulu*, the scratch-brush is used less freely than usual; the work is then *restored* by heating it more highly than when it is to be left *mat*, and it is afterwards allowed to cool a little. The *or moulu* colouring is a mixture of the red oxide of iron, alum, and common salt; these are ground up with vinegar, and applied with a hair pencil, over the surface of the gilding, but taking care to avoid the parts to be burnished: the piece is then placed upon lighted charcoal, which may be rendered more active by gently blowing it; the heating is continued until the work begins to assume a black colour. The piece should be made sufficiently hot to cause water sprinkled upon it to be rapidly converted into steam. The article is then withdrawn from the fire, and plunged into cold water; it is to be well washed, and the orange colour which the gilding presents, is equalized by rubbing over the piece a hair pencil dipped in vinegar, if the surface be smooth; or in weak nitric acid, if it has been ornamented with the graver, or the chisel (chased or repaired). In either case, the article is to be well washed, and dried at a moderate fire.

8th. *On producing the Colour of Red Gold.*—When the gilding is to receive the colour which distinguishes the triple alloy of gold, silver, and copper, usually employed in the manufacture of jewellery, this is effected by the subjoined operation.

The work, when sufficiently gilt, is, whilst warm from the fire, to have a fine iron wire attached to it, and is then immersed in, or covered with, the composition known under the name of *gilding-wax*; this is made of yellow bees-wax, red ochre, verdegris, and alum; when thus prepared, it is heated strongly over a charcoal fire, and the inflammation of this covering of wax is promoted, by throwing some drops of the wax into the fire; the work must be turned over and over upon the fire, so as to heat it, and burn off the wax from every part of it, at the same time; when the whole of the gilding wax is burned off, and the flaming has ceased, the piece is to be plunged into water and well washed; it must then be scratch-brushed, using pure vinegar in that operation. If the colour is not good, nor the tint equal all over the piece, the piece should be covered over with verdegris ground in vinegar: it must then be dried on a gentle fire, again be plunged into water, and scratch-brushed with pure vinegar; but should the colour be too dark, a little weak nitric acid may be used instead of the vinegar. After being coloured, the work is to be washed, burnished, again washed, wiped with soft linen, and dried by a gentle heat.

In performing the above processes, the utmost care is necessary, to avoid the deleterious effects of the mercurial and other fumes. Great numbers of persons have fallen early victims to this business, or, after a few years devoted to it, have been rendered helpless for the remainder of their lives. To obviate these fatal effects, M. D'Arcet has devised such arrangements in the gilding hearths used in the large manufactories, as to cause them completely to carry off the vapours, without exposing the workmen to their action. It is of high importance, however, to avoid the mercurial vapour, even in a single operation, especially when large pieces are to be gilt. For this purpose, the hearth chimney should have a strong draught, the air for which may be supplied by tubes leading from the outside of the building, and which may be regulated at pleasure, whilst that from the doors and windows is always irregular, and indeed, if admitted in sufficient quantity, would frequently render the workshops uncomfortable.

M. D'Arcet advises the gilders not to touch the mercury with their naked hands, when it can be avoided; and either to wear gloves of leather, or of bladder; or, which is still better, of waxed (oiled) silk. Before leaving the workshop, and especially before eating, both the hands and the mouth should be carefully washed with warm water, and the hands afterwards with soap and water, to completely remove the amalgam, and the nitric solution of mercury.

Cold Gilding on Metal.—Dissolve about sixty grains of fine gold, rolled very thin, and ten or twelve of pure copper, in two ounces of nitro-muriatic acid *(aqua regia.)* When the solution is completed, it is to be poured, drop by drop, upon clean linen rags, sufficient in bulk to absorb the whole of the liquid; these are to be dried, and then placed upon a china plate, and reduced to ashes; taking care in lighting them not to use a sulphur match. These ashes, of course, contain the gold and copper in fine powder.

When a piece of metal is to be gilt with this powder, it must be prepared, by being left with a clean surface, such as is given by rubbing it with a fine blue-stone or charcoal; a small pad of linen is to be slightly moistened, and then dipped into the box containing the powder; with this the work is to be rubbed until its surface is sufficiently covered with the gold. Large articles are afterwards burnished with blood-stone burnishers, and smaller ones with those of steel, using soap-suds, to prevent scratching, or stripping off the gold.

LX.—*On the advantages of Extracting the Fecula from the Sweet Potato.* By G. G. BARRELL, *Esq. Consul of the United States of North America, at Malaga.*[*]

DEAR SIR, *Malaga, September* 26, 1826.

PERMIT me to communicate to you the result of an essay which I made, some days ago, on the sweet potato, a native of the country you so worthily represent; and where, I think, that the use to which this excellent vegetable is generally applied, may be extended to great advantage.

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[*] From the *Franklin Journal* of January, 1828.

You, no doubt, have heard of the vast consumption which has lately taken place in France of the fecula, or flour of the common potato; where, in consequence of the repeated certificates given by the *Proto Medicale* of Paris, it has been introduced into almost all the apothecaries' shops, and the hospitals, in the south of France, and is found to produce a variety of the most delicate and nutrimental aliments, for people afflicted with a weak digestion and relaxed intestines; such as excellent gruel, porridge, and all kinds of pastry, far superior to that made with flour; as also starch of the very first quality, and which nothing, apparently, could exceed in whiteness.

A consideration of these facts first induced me to turn my attention to the sweet potato, and suggested the idea, that it might be applicable, in some degree, to the same purposes; and having accordingly resorted to the process usually adopted, for extracting the fecula of the common potato, I found, to my no small surprise and satisfaction, that it produced that substance *in vastly greater quantity*, and, if possible, *of a superior quality*, particularly in whiteness; besides possessing, in a great degree, the *saccharine quality* inherent in the plant.

These circumstances will, no doubt, suggest the idea, to a person of your active and penetrating mind, of the immense advantages that would unquestionably accrue to the southern states of America, from applying this admirable vegetable to the many purposes of which it is susceptible. I shall therefore proceed to describe to you the simple method which may be used for the extraction of the fecula. It is as follows:—

A wooden cylinder is required, of about three feet in circumference, and four in length, covered with iron tinned plates, perforated like a grater, which, on wearing out, may be taken off and renewed; on the top is placed a wooden box, or hopper, capable of containing five or six bushels of potatoes, in such a manner as to embrace about a quarter of the circumference of the cylinder, and so adjusted to it, as only to let the fibres of the potatoes pass, in the operation of grinding. This cylinder, with its hopper; is placed upon a tub, of an oval form, filled with water, in such a manner as that the cylinder should constantly dip into the water during its rotation, which is performed by means of a winch or handle, affixed upon the axis of the cylinder, upon which a fly-wheel may also be mounted; and thus the pulpy and fibrous substances are constantly washed off the surface of the grater, and it is thereby kept clear; the fecula thus falling, together with the fibrous substance, into the water, a separation immediately takes place; the fecula, by its superior specific gravity, precipitating itself to the bottom of the tub, where, in a few minutes after pouring off the water mixed with the fibres, it appears white, and in a solid compact mass, In order to complete the operation, nothing further is requisite than to stir it up, mixed with clean water, and percolate it once or twice through a sieve, when it becomes of a whiteness far surpassing that of common flour or starch, and it is also of a more glutinous and tenacious quality than the latter substance.

From the experiment I made to ascertain the quantity of fecula produced by the sweet potato, I find that four and a half bushels of that vegetable, when at maturity, will produce one bushel of fecula, which is at least 50 per cent. more than the produce of starch from the common potato in this country. It has, besides, the great advantage of being fit for use in making starch all the year round, if properly preserved, it being only in a very small degree subject to germinate; whereas the common potato, on beginning to sprout, produces very little fecula, and is in a state fit for grinding only about five months in the year. The fibres of both kinds of potatoes make excellent food for cattle, pigs, sheep, fowls, &c.

The fecula, when extracted, is dried in the sun, on thin plates, either of earthenware or tin; and it may be formed into any shape, or made fine like flour.

In order to facilitate the operation, on a grand scale, two or more cylinders may be driven at the same time, placing them within about three or four inches from one another; by which means great quantities of potatoes may be ground in a day, without employing more than the power of one man. In a country, however, where the powers of water machinery and steam are so well known, as in America, it would be useless and impertinent to make further observations on that subject; I shall therefore conclude with a few observations on the washing of the potatoes, previous to grinding of them for extracting the fecula. This operation is of the greatest consequence, and in fact is the only laborious part of the process, as it is usually conducted, as great care must be taken to have the potatoes well washed, in order to prevent the earth accompanying them from mixing with the fecula; and it appears to me that a more expeditious method might be invented than the common one; as, for instance, by suspending horizontally a long cask, which may be turned like the above mentioned cylinders, by hand; this might be filled about two-thirds full of potatoes, and be afterwards filled nearly full of water. It should be furnished on the inside with strong bristles, in the form of hard brushes, with here and there long wooden pins, rounded at their ends, to prevent the bruising of the potatoes too much in the act of rotation, which should be very violent. The cask should likewise have a cock or plug fitted in it, for drawing off the water when soiled, and which may be renewed, till the potatoes are thoroughly cleansed. The whole of this operation may be performed in a very few minutes.

I am, Sir,
Your infinitely obliged,
And very faithful servant and friend,
G. G. Barrell.

To H. A. S. Dearborn, *Esq.*
Boston, U. S.

LXI.—*Notice of some important Improvements in Heating Forcing-Houses.* *By Mr.* George Cottam, *Engineer.*

SIR, *Winsley Street, Oxford Street, London, 25th April,* 1828.

I am sorry to learn that your plates are filled up for this month,* or I should have embraced the opportunity of laying before your readers what I conceive to be a very great improvement in the hot water circulatory apparatus, for the purpose of heating houses for forcing early fruits. This system, for economy in fuel, cleanliness, and convenience in form, far surpasses all others, and even in the first cost, the erection is less expensive than any other apparatus, or even than the common flues. Drawings and descriptions of some successful applications shall, however, be ready for your next number, which will satisfactorily prove that boilers to contain great quantities of water are quite *unnecessary.*

I am, Sir,
Your most obedient servant,
Geo. Cottam.

To Thomas Gill, *Esq.*

LXII.—*On the Preparation of Hemp and Flax without Water-Retting.* *By* M. Nicolas.†

In order to avoid the evils of water-retting, M. Nicolas, after having accurately analysed hemp, proposes to obtain its filaments, as well as those of flax, by simply exposing the plants to the action of the dew (dew-retting); he remarks that the process is practicable every where, and that it does not give any offensive smell to the hemp, nor injure its quality. This easy process is already employed in the Department of the Vosges, where, beyond doubt, it was first practised; and M. Nicolas, in now pointing it out to notice, proves that it has been overlooked in the modern improvements of the art; and finishes, after his successful experiments, by reverting to the fact, that it is the very means indicated by nature.

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* All Articles which require Plates or Figures to elucidate them, should be forwarded to us before the middle of the month.—Editor.

† From *Mémoir de la Soc. Royale de Caen,* and Ferussac's *Bulletin des Sciences Technologiques.*

M. Nicolas, however, afterwards employs an active and cheap solvent to free the hemp from its gummy-resinous parts, which resist the action of the dew. He puts into a tub one hundred pounds of the filaments, bound and tied into bundles or handfuls; and to bleach the fibres he makes a mixture of fifty pints of spring water, to which he adds two pounds of potash;* when the solution is effected, he adds four pounds of common oil, and by the assistance of heat, forms a saponaceous liquid, marking about twenty degrees of the areometer, and which he then pours upon the hemp in the tub. He withdraws this lie in two days' time, and heats it to eighty-five degrees of the centigrade thermometer, when he again pours it upon the hemp. On the third day he rubs the filaments between his hands, to wash them thoroughly; and lastly, dries them. In this process the fibres become soft, they make but little tow, and are very readily spun.

LXIII.—*On preserving Wines in Draught.* *By* M. IMERY.†

M. IMERY, of Toulouse, has given us the following simple means of preserving wine in draught for a considerable time; it is sufficient to pour into the cask a flask of fine olive oil. The wine may thus continue in draught for more than a year.

It is by a similar process, that they preserve wine in Tuscany, which they are accustomed to keep in large bottles, the glass of which is too thin to resist the effect of corking them tight. The oil, spread in a thin layer upon the surface of the wine, hinders the evaporation of its alcoholic part, as well as prevents it from combining with the atmospheric air, which would not only turn the wine sour, but also change its constituent parts.

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* Would not soda be better?

† From *Journ. des Science Usuelles;* and Ferussac's *Bulletin des Sciences Technologiques.*

LIST OF PATENTS FOR NEW INVENTIONS,

Which have passed the Great Seal since March 25, 1828.

To Jane Bentley Lowry, wife of Thomas Sampson Lowry, of the city of Exeter, straw hat manufacturer; for certain improvements in the manufacture of hats and bonnets. Dated March 25, 1828. —To be specified in six months.

To Edward Cowper, of Clapham Road, in the parish of Saint Mary, Lambeth, in the connty of Surrey, gent.; for certain improvements in cutting paper. Dated March 26, 1828.—In six months.

To Ferdinand de Tourville, of Piccadilly, in the county of Middlesex, merchant; for certain improvements on filtering apparatus. Dated March 26, 1828.—In six months.

To Thomas Lawes, of the Strand, in the county of Middlesex, lace manufacturer; for an improved thread, to be used in the manufacture of the article commonly called bobbin-net Lace. Dated March 29, 1828.—In six months.

To Henry Marriott, of Fleet-street, in the city of London, ironmonger,; and Augustus Siebe, of Princes-street, Leicester-square, in the county of Middlesex, mechanist; for certain improvements in hydraulic machines. Dated March 29, 1828.—In six months.

To Peter Taylor, of Holmwood, in the county of Lancaster, flax dresser; being one of the people called quakers; for certain improvements in machinery for hackling, dressing, or combing, flax, hemp, tow, and other fibrous materials. Dated March 29, 1828.—In six months.

To John Davis, of Lemon-street, Goodman's Fields, in the county of Middlesex, sugar refiner; who, in consequence of a communication made to him by a certain foreigner residing abroad, is in possession of an improvement in boiling or evaporating solutions of Sugar, and other liquids. Dated March 29, 1828.—In six months.

To Charles Harsleben, of New Ormond-street, in the county of Middlesex, esq.; for certain improvements in machinery, to be used in navigation, chiefly applicable to the propelling of ships, and other floating bodies, and which improvements are also applicable to other purposes. Dated April 3, 1828.—In six months.

To Samuel Wellman Wright, of Webber-street, Lambeth, in the county of Surrey, engineer; for an improvement or improvements in the construction of wheel carriages; and in the machinery employed for propelling, drawing, or moving wheel carriages. Dated April 15, 1828.—In six months.

To John Gosslieb Ulrich, of Cornhill, in the city of London, chronometer maker; for certain improvements on chronometers. Dated April 19, 1828.—In six months.

GILL'S
TECHNOLOGICAL REPOSITORY.

LXIV.—*On the Microscope. By the* Editor.

WITH A PLATE.

(Continued from page 264.)

On other Configurations produced by the triple mixture of Salts, termed by the Editor the "Microscopic Kaliedoscope.—We shall occasionally bring before the notice of our readers, such varieties, amongst the almost infinite combinations of symmetrical forms afforded by this mixture of salts, in our "*Technological Demonstrations*" upon the uses of the microscope, as may appear most worthy of attention.

In plate VIII. figs. 1, 2, 3, and 4, represent four of these configurations, in which several of those elementary forms, already given in plate VI. of our last number, will again be seen, but ramifying more extensively; and one of a new shape is also given in fig. 4.

There is indeed no end of the beautiful arrangements continually forming under the eye of the observer, during the progress of these investigations, and which indeed must be seen to be understood; as all endeavours of the artist to seize and to perpetuate them, can but afford a very incompetent idea of their real structure.

Mr. T. Carpenter's observations on the natural history of the insect termed the Formica Leo, or Ant Lion.—The Editor having mentioned in his last number, page 258, that the fangs of the plant louse lion very much resembled those of the *formica leo*, or ant lion; Mr. Carpenter has since informed him, that a friend of his had sent him three living specimens of that insect from Paris, it being a native of the south of France, and which he kept in that state for some time, watching their very curious habits, and manner of feeding. They had the singular property of being capable of running backwards with equal facility as forwards. On a recent visit to him, Mr. Carpenter placed a specimen of this insect under the microscope, in order that the Editor might observe its very formidable appearance; and, in particular, the construction of the powerful fangs with which it seizes its prey. He has also since kindly favoured him with the loan of the insect, in order to afford. the opportunity of having its head and fangs delineated and engraved.

In plate VIII. fig. 5 represents these parts; each fang having three sharp teeth, in addition to its acute and curved point, besides several stiff spines, which also contribute their aid in the seizing and destroying of its prey. It has two pairs of eyes, one pair of compound ones, and another of single ones, mounted upon slender stems.

On the Natural History of the Formica Leo.—This is an insect of a most ferocious appearance and habits, and is called the ant lion from the stratagems it employs to take the ants, to whom it is a most formidable enemy. In order to capture them, it forms a pit in the sand, in the shape of a cone, or funnel, and using its broad flat head and fangs as a shovel, it throws out the sand to a great distance; the pit being thus finished, the insect buries itself amongst the sand at the bottom or apex of the cone, leaving only its eyes and fangs out of the sand; here he patiently waits for his prey, and when an ant or any other small insect happens to creep over the edge of the cone, its movements throw down some of the particles of sand, and thus gives the lion ant notice of its presence, who instantly throws up more of the sand which covers its head and fangs, and thus overwhelms the ant; and, by its returning force, brings it with it to the bottom of the cone; he then continues to throw more sand upon it, until the insect is overcome, and falls between his fangs. Every attempt at escape when once the incautious ant has stepped within the verge of the pit, is in vain; for in all its endeavours to climb the sides of the pit, the deceptious sand slips from underneath its feet, and every successive struggle precipitates it still lower. When at length it is brought within reach, its enemy plunges the points of his fangs into its body, and having sucked out all the juices it contains, throws out the empty skin to a considerable distance, in order that the trap may not become terrific to other insects, from their seeing the carcases strewed around it; this done, the insect mounts up to the edges of the pit, and repairs whatever injuries it may have sustained; and then descending again, conceals himself at the bottom as before.

The fangs of this insect are hollow, and serve as tubes to draw into its stomach the juices of the insects upon which it feeds; for it has no mouth, nor any other organ capable of answering the purpose of one. The fangs being therefore so necessary to its existence, nature has provided the means of restoring them, in case of accident; for if cut off, they are found to grow again.

When about to change into a crysalis, the insect leaves its pit, and buries itself under the surface of the sand; it then incloses itself in a fine web, spun in the manner of the spiders, and a quantity of grains of sand are cemented on the outside of it, by means of a glutinous matter which exudes from its pores; after which, it spins an internal case, of exceedingly fine and soft silk, within which it changes into a pupa; and, after the manner of many other insects, remains in a torpid state for some time, and then finally changes into a fly, the size of a small *libellula*, or dragon fly. Mr. Carpenter showed the Editor one of the cases above described, made of grains of sand agglutinated together; and also informed him, that the insect was finally transformed into a winged one, which, as above stated, much resembled in its appearance a *libellula*, or dragon fly.

On the Fangs of the Larva of the Dityсus, or large

Water Beetle.—The Editor kept one of these larva for some time in a vessel of water, covered with the *lemna* or duck-weed, under which it usually lurked, and seized the animalcules contained in the water, which served for its food. During this period, it repeatedly cast off its exuvia, one of which the Editor was able to preserve, and to place between talcs, in a slider, as a fine transparent object for his microscope.

In plate VIII. fig. 6 represents the head, fangs, and feelers of this voracious larva, as they were enclosed in the exuvia, and which also shows the marks of the openings or rents in it, through which it made its way out of the exuvia. The eyes of the perfect insect or beetle are, as we have mentioned in page 195, compound ones; but in the larva state, they are enclosed, and only possess the power of vision through diagonal slits, formed on each side of the head, as represented in our figure.

Mr. T. Carpenter's observations on the singular modes employed by Insects to free themselves from the Ticks with which they are infested.—Mr. Carpenter lately showed the Editor under his microscope, as an opaque object, a small green beetle, the body of which was covered all over with minute and slender splendid irridiscent scales (the *curculio nigrorostris).* To the leg of this beetle a species of *obesium,* commonly termed the lobster insect, was attached. (This latter insect is figured in Adams's work on the Microscope, edited by Messrs. Jones, in plate XVIII.) Mr. Carpenter favoured the Editor with the following very singular account of these insects. "When I first caught the beetle, I found the lobster insect firmly attached by means of its claws to one of the legs of the beetle, and naturally concluded that it was in the act of preying upon it; and, what more fully confirmed me in this opinion was, that when I separated the two insects, the lobster insect made a spring at the beetle, and instantly fixed itself in the same situation on its leg as before. I then put them both into a small watch glass, covered with a flat circular glass in order to prevent their escape, and placed them under my microscope to ascertain in what manner the lobster insect was carrying on its depredations, when, to my great surprise, I discovered that so far from the little creature being, as I supposed, an enemy to the beetle, it proved in fact to be one of its best friends; for I could distinctly see that the lobster insect had one of its large claws securely fixed upon the leg of the beetle, whilst the other claw was employed in picking off the very minute *acari* or ticks with which the beetle was infested, from the under side of its body, and carrying them to its own mouth, instantly devoured them!

" I have also, since then, frequently seen the large house fly come out of its winter quarters, on a fine spring day, with one of these lobster insects attached to its leg; and, on examining the fly, have found numerous ticks upon its body, by which it had been infested while in a torpid state. The lobster insect was thus performing the same friendly office in this case as in the former instance."

Mr. Carpenter also mentioned an instance of a friend of his seeing a bee alight upon an ant's nest, and which was instantly covered with ants; this circumstance naturally exciting his curiosity, he watched the result with the assistance of his hand-magnifier, naturally expecting that the bee would have fallen a prey to the ants. Instead of this happening, however, he found that the ants were only freeing the bee from the numerous ticks with which it was infested; and, immediately upon this being effected, the bee, by a sudden movement, drove off the ants, and took to flight.

On the habits of another species of Lobster Insect.—Mr. T. Carpenter exhibited to the Editor lately, under his microscope, a species of this insect in a living state; and which he found a few days since on a wine bottle in his cellar. While in that situation he examined it with a hand-magnifier, and found that it was hunting about over the surface of the bottle, and occasionally seizing and devouring any minute ticks which happened to come in its way. Its usual mode of crawling was onwards, also pushing forth its long arms, and the sharp pointed claws at their ends, in order to seize its prey; but if these claws were touched with the point of a needle, or any thing else, it was astonishing to see with what rapidity the insect ran backwards; and, indeed, when running in that direction, its motion was so quick, as almost to appear like leaping. Besides these claws, the insect is furnished with a double pair of jaws, with strong sharp cutting teeth; and appears a most formidable creature in comparison with its size, which is not larger than that of a common flea.

On the compound Eyes of the large French Crayfish.—The Editor on lately dissecting one of these eyes, found that the optic nerves all radiated from, and were placed in contact with, a white hemispherical body, which evidently was part of the brain of the animal, and protruded in the centre of the short oval crustaceous tube, upon the top of which the eye was placed; and as shown in plate VIII. fig. 7.

He has also accidentally found, that the square tubes in these eyes, described in page 195, are readily divisible in their length into four longitudinal parts or branches, as seen in fig. 8: and, indeed, as is likely to happen from their construction, a square tube with an aperture through its centre, being exceedingly thin in the middle of each of its sides.

This accident arose from endeavouring to separate a cluster of these tubes, placed between two glass slips, by rubbing the glasses upon each other, and should indicate the necessity of avoiding such friction in mounting them as objects for the microscope.

Mr. T. Carpenter's improved mode of taking the Podura.—He finds, that on laying a few small heaps of wheaten flour, upon dark coloured paper, in the cellars frequented by these curious insects, they very soon are attracted thereby; and, on placing the paper in a bason, they leap out of the flour, and may then, on removing the flour, be very readily transferred from the bason into any other receptacle provided for them.

On viewing the Poduras as opaque objects in the microscope.—Mr. Carpenter finds that the poduras afford most beautiful irridiscent objects when viewed in this manner; a proof that their transparent scales or feathers are delicately furrowed. This fact has been lately confirmed by their appearance when recently viewed by him in Mr. Tully's new combination of two sets of triple achromatic object glasses combined, just completed; and, indeed, this combination exceeds in its performance every microscope Mr. Carpenter has ever before witnessed, the most difficult test objects yielding to its powerful effects!

On the natural history of the Asparagus Beetle.—Mr. T. Carpenter informed the Editor lately, that in the summer months, small black grubs, of a rather disgusting appearance, are found attached to the stems of asparagus plants. These are the larvæ of the *crysomela asparagus*, usually termed the asparagus beetle; a figure of which is given in Adams's work on the microscope, plate XX.; but wanting colour, cannot of course give any adequate idea of that beauty which the insect possesses.

The method which Mr. Carpenter took in order to ascertain the various changes which the insect underwent in its progress from the larva state to its final appearance in the perfect state, was as follows:—In the month of July he selected several of the larvæ, and placed them under an inverted glass vessel, together with some portions of the asparagus plant, for them to feed upon. In a few days he observed the skin of several of them bursting open at the head, and which skins were thrown off by the insects, when these appeared in the pupa or crysalis state; and in about a fortnight afterwards the perfect insects came forth.

In order to show his friends the interesting progressive changes of these insects, he put them, in their various stages, into spirits of wine; and the Editor had the pleasure of seeing them exhibited under his microscope in the following order:—First the larva as in its feeding state:—Secondly, the same with the skin opening at the head ready to be cast off by the insect preparatory to its change into the pupa state; and also some of the cast off skins mounted upon card as opaque objects:—Thirdly, various stages of the pupa, in which were seen the rudiments of the wing cases; another pupa in a more advanced state, with the wing cases in a more expanded state, and the reticulations in its eyes just visible:—Fourthly, the insect in a very near approach to the perfect state, with its wing cases and wings fully thrown open; and, lastly, the change into the perfect insect. The latter insect, bred by Mr. Carpenter in the manner above described, he had mounted on the further end of a narrow slip of card, which card was held in the forceps, and the insect was then viewed in the microscope in the manner of viewing opaque objects, and as it would appear in its natural living state. It was magnified to about six inches in length, and was one of the most beautiful objects imaginable. Its general colour was black, but its thorax was red, and it had curiously formed orange-coloured spots upon its elytra or wing cases.

Some of these larvæ had been pierced by an ichneumon fly, which had deposited its eggs within the bodies of the larvæ, from which were excluded minute worms, which fed upon the interiors of the larvæ for their usual time, and then eat their way through their skins, and spun small cocoons; and shortly afterwards, a race of small ichneumon flies came forth. These flies appear to be agents in the economy of nature, designed to preserve a due balance amongst this tribe of insects.

Mr. Andrew Pritchard's Sapphire Lens.—The Editor has just caused one of these excellent lenses to be mounted to his Varley's single microscope, by Mr. Pritchard; its focus is about the twenty-fifth part of an inch; but, owing to its high refractive power, objects placed between plate glass slips, of the twentieth part of an inch in thickness, are readily accessible to it, and can be viewed with great ease and advantage, on account of the great quantity of light admitted. It is indeed the pleasantest single lens to use he has yet met with.

On the situation of the Teeth and Jaws of the Mite.—The specimen of a species of *obesium* which was presented to the Editor alive, as mentioned in the former part of this article, by Mr. T. Carpenter, having died, the Editor placed it between talcs in one of his ivory sliders, to preserve it as an object for his microscope; however, the pressure of the talcs upon it having caused its juices to exude, to the hindrance of its distinctness, Mr. Carpenter advised him to wash it in water, with a view to the removal thereof, and accordingly he followed that advice, and afterwards placed it between two thin slips of Bohemian plate glass, in the moist state. On examining it with the above sapphire lens, he was surprised to find that it had protruded from its double pair of jaws appendages exactly resembling those which Mr. Carpenter had so fortunately and completely separated from those of the cheese-mite, and of which we have given figures in plate III. of the present volume. On this, the Editor showed the object to several of his friends in this state, who confirmed him in his belief, and he had hoped to have preserved the object in that state. Unfortunately, however, on the water drying up, these exceedingly delicate appendages shrank close to the other parts of the object, and disappeared from view.

It is nevertheless satisfactory to have thus ascertained their places in the jaws of the mite and the obesium; and it may afford an interesting pursuit to those amateurs of the microscope, who, unlike the Editor, may have leisure more fully to investigate the subject. The obesium is preferable to the mite for this purpose, on account of its size being more considerable.

Mr. P. Carpenter's Solar Microscope, with Achromatic Object Glasses.—We are glad to announce that Mr. Philip Carpenter is now preparing a very superior solar microscope, for opaque, as well as transparent, objects, and with achromatic object glasses worked by the celebrated Mr. Tully, of Islington. If we are not greatly deceived in our expectations, this microscope will produce effects much superior to what has hitherto been seen, and will prove a valuable addition to his microcosm. Mr. Carpenter has now engaged a proper person to superintend the exhibitions, and to provide a continual change of aquatic animalculæ and other living objects in their due seasons.

(To be continued.)

LXV.—*On simple and economical methods of Heating Hot-houses, Pinerys, Stoves, Green-houses, Conservatories, &c. By Mr.* GEORGE COTTAM, *F.H.S.*

WITH A PLATE.

DEAR SIR, *Agricultural Implement, and Engine Manufactory, Winsley Street, Oxford Street, London, May* 20, 1828

HEREWITH I send you drawings of two methods of fitting up in pinerys, green-houses, &c. different apparatus for circulating hot water; the one on the right of the boiler A, plate IX. fig. 1, was erected by me in a pinery, 80 feet long, and 10 feet wide, with a wall in the middle of it, to divide the pit into two parts; the boiler was placed in the partition wall, and a single pipe proceeding from it was carried round each end of the pit, and continued across the middle of it into the boiler again, and it thus may be considered as being an endless pipe. It was not returned again at a lower level, as has hitherto been done. In this double pit there are only employed 180 feet of four-inch cast-iron pipe, being half the quantity usually required. The pipes, with the boiler, held 180 gallons of water, the boiler itself containing from 25 to 30 gallons. Some time after this apparatus was fixed up, the following observations were made, in order to ascertain if it produced a sufficiently warm temperature in the pinery to keep out the frost with a moderate fire; a thermometer was placed in the open air, another in the pinery, and a third in the boiler; at six o'clock, A.M. the temperature of the open air was 26 degrees, being six degrees below the freezing point, the pinery was at 65 degrees, and the water in the boiler at 138 degrees. At six o'clock on the following morning the external air was at 40 degrees, the pinery at 61 degrees, and the water in the boiler at 120 degrees, the weather being cold and rainy. This is a satisfactory proof that this mode of heating forcing-houses will supply a sufficiency of heat for all required purposes. If a higher temperature were, however, required, it could be easily produced by increasing the heating surface with an additional quantity of pipe, as shown on the left side of the plate, which is an arrangement suitable for a green-house or conservatory, where the pipes are required to be placed under the floor.

The boiler may be either fixed in the middle of the house, as shown in the plate, which more equally divides the lengths of pipe, and equalises the circulation of the water, or it may be placed at one end of the house, as convenience of situatian may require. The open topped elbow B of the double pipe gives every facility to the circulation that an oblong open tank or cistern can do, and will be found more convenient, as occupying less space, and being less expensive.

Fig. 2 is a section of the boiler used, and which is preferable to those of any other shape in point of economy in fuel, in exposing the greatest bottom surface, and containing the smallest quantity of water, adequate to the purpose, which is possible. The bottom receiving the greatest portion of heat from the fuel, and the water conveying that heat quickly into the house to be heated, as well also for giving rapidity to the circulation of the water through the pipes, and thereby more equally diffusing the heat throughout the house. The dome-shaped bottom of the boiler increases the surface for receiving the heat, and the check draught in the fire-place compels the heat to come into contact with the whole surface of the bottom, and, at the same time, prevents a great consumption of fuel from taking place. The flue is carried round the boiler in the usual way, to receive the greatest possible quantity of heat from the flame.

I am, Sir,
Your most obedient servant,
GEO. COTTAM.

To THOMAS GILL, *Esq.*

LXVI.—*On the Propagation of the Begonia. By the* EDITOR.

WITH A FIGURE.

IN the spring of last year the Editor had a root of the Begonia planted in a garden pot, and placed upon a bracket, situated near to the upper part of a window facing to the west. In this state it was exposed to the warmth of a room heated by a fire, used for culinary and other purposes, and was regularly watered every day. It produced one stem only, which branched off into two, and so continued to subdivide until towards autumn, when it flowered, and only the male flowers were visible from below, no female ones being perceptible, owing to the elevated situation in which the plant was placed. However, towards winter, the stems and leaves began to decay, and shortly afterwards to separate from the root. In this state the Editor proceeded to remove them, but was very much surprised at finding in the angle of each forked branch a regularly formed egg-shaped body of a green colour, marked with yellow spots all over it, and the rudiments of leaves at the top of it. On subjecting a thin slice of one of them to the test of the microscope, he found that it contained a farina, the minute vesicles of which were of a regular oval shape, unlike those of the potato, which are of irregular forms, resembling those of the potatoes themselves. It appeared to the Editor that these bodies evidently were created to serve some useful purposes, and that probably they were the *germs*, intended as a means of propagating the plant, and accordingly he preserved them in an open mouthed bottle till the spring, when, on replanting the root of the bigonia, he put four of the germs into the soil around it. He had the satisfaction of finding them vegetate, but as it might have happened that what he took to be the shoots from the germs, were produced from the root, as well as the two stems, which it now has afforded; so, to remove all doubts upon the subject, he planted the remaining stock of germs in another pot, and has again had the pleasure of producing numerous young plants therefrom.

He knows not whether this fact may be generally known, it was new to those scientific friends to whom he has mentioned it, and certainly deserves to be made better known, as an excellent mode of propagating this beautiful plant in an extensive manner, as the plant in his possession afforded at least twenty of these germs or seeds, as they may be termed.

He has given a figure of one of the largest of these germs in plate IX. fig.3, with its situation also shewn in the angle between the forked branches of the plant.

LXVII.—*On a natural means of Stocking Ponds, situated on hills, with Fish. Discovered by* THOMAS SNELSON, *Esq. Secretary to the London Western Literary and Scientific Institution.*

IT has long been considered as a difficult point to ascertain the means by which mountain streams or ponds situated upon hills become stocked with fish; for although it is well known that the salmon has the means of making its way up against rapid water falls by its powerful muscular action, yet this is by no means the case with the generality of those fish with which streams and ponds thus circumstanced are filled. Mr. Snelson, however, many years since, ascertained the important fact, that the large water beetle, which is in the habit of feeding upon the spawn of fish, occasionally in the evening climbs up the stems of rushes, &c. out of the water, sufficiently high to enable it to take wing, and he has caught it in its flight, and putting it into water, found that it gave out the spawn it had gorged itself with previous to its taking flight, both in a digested and in an undigested state, so that on trial he ascertained that it produced fish of various kinds.

This discovety thus ascertained one mode at least by which this apparent difficulty may be overcome, and, no doubt, nature also employs other analogous means of accomplishing this important end.

LXVIII.—*On the Swiss method of Blueing Iron and Steel.**

IRON and steel articles, when their surfaces are polished, whether simply by the file or by rubbing with emery, putty of tin, &c. are susceptible of receiving a blue colour from the action of heat; and which is rendered more beautiful or deeper, in proportion as the surface is more perfectly polished, or the operation more perfectly performed.

Every worker in iron and steel supposes himself to be capable of properly blueing the articles which he has made; but very few of them succeed well in it. There are some workmen, however, who, by great experience, excel in this branch, which may be considered as an art in itself. Clock and watch-spring manufacturers, and more particularly the makers of watch-springs, succeed very well; but the manufacturers of the steel hands for watches have attained the highest point of perfection in it.

By means of heat, steel is made to receive a series of iris colours in the following order: viz. straw-colour, orange, red, pigeon's-breast, or purple, violet, blue, and grey. Iron will receive the same colours, but is not susceptible of taking such vivid tints as steel. When steel has been hardened, it must be tempered before it can be finished; and it must be softened more or less, according as it is necessary for the article to possess a greater or a lesser degree of hardness in use. In some cases it is not necessary to give an equal colour to the whole length of the article, as the colour is frequently removed in the successive operations. It is nevertheless advantageous, however, that it should be as equal as possible, in order that the degree of hardness may be uniform throughout. It is a very different case when the articles are finished and well polished, and are intended to remain blue; such, for instance, as the hands of a clock or watch: as then, if the blue is not perfectly equal, and very deep, it presents a disagreeable appearance. The following method appears to us to be the most advantageous; and we have seen it practised by the workmen in Geneva, and other parts of Switzerland, who excel in this art; it has also been successfully employed by many workmen in Paris. In a kind of stove made of sheet-iron, they place turfs, made of spent tanner's bark, or merely dried tan: these are covered with lighted charcoal-dust. The fire soon communicates to the turfs, or tan-dust; when these begin to burn, they place the pieces intended to be blued upon them, taking care that the ashes do not cover them, in order that they may see the colour which they assume. It is requisite to be very careful that the heat be uniform, and that it be retained at exactly the same degree, without being too great; as, in that case, the operation would fail entirely, and the blue colour soon disappear, and turn to a grey; the article would also lose its hardness, it must be hardened afresh, and there would be a very great chance of its being over-heated. In order to avoid these inconveniences, we should prefer a fire less active, and operate by degrees. When the well polished steel has acquired a red colour, and it is seen that this colour is not perfectly uniform, the greatest heat must be directed towards the part where the colour is least intense, by blowing with the mouth that part of the fire adjacent to it. By this means, and with great care and patience, a beautifully uniform and deep blue colour is obtained.

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* From the *Dictionaire Technologique*, and translated in the *Franklin Journal.*

When the article has become of a red colour, if it is found to be clouded with various shades, it is better to suspend the operation, and polish the article afresh, either with emery, tripoli, *crocus martis*, putty of tin, &c. and entirely to begin anew; rather than expose the article to too great softening, We can only here point out general rules; there exists in every art a kind of dexterity which practice alone can give.

When the article has acquired the desired colour, it is withdrawn from the fire, and allowed to cool slowly, when it must be wiped with a clean, dry, linen cloth. Particular care is required not to touch the articles when finished, with greasy or damp fingers; but above all, not to dip them in oil, as they would become dull, and lose that lustre in which consists all their beauty. This blue colour remains for a long time; nevertheless it is subject to change; it which case it may be restored to all its freshness, by the article being polished anew, and again submitted to the same operation.

Iron never takes so fine a blue as steel, as it does not receive so good a polish, neither is it so hard; and it is probable that the carbon contained in the steel has some influence on this operation.

LXIX.—*On an improvement in Turning Lathes. By Mr.* RUFUS TYLER, *Engineer, Philadelphia.*[*]

WE have given in vol I. page 27, a description, with an engraving, of Messrs. Mason and Tyler's, of Philadelphia, improved lathe, to which we refer our readers. Mr. Tyler has since then directed the attention of mechanics to the important fact, that *cast iron* is superior as a collar to the hard steel mandrel of a lathe, to the hard steel collars usually employed; it also diminishes the labour of making it, and affords a solid, in place of an inserted, collar; besides which, the lathe is found, by experience, *to run a much longer time without requiring to be fresh oiled*, than when the steel collar was used.

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[*] From the *Franklin Journal.*

Mr. Tyler has also mounted his lathe upon a cast-iron stand, instead of upon the table and nests of drawers, as shown in our plate; holes being made in the frame for the pivots of the treadle and the crank-axle to turn in; the lathe is thus better adapted to the usual run of work than when fitted up in the originally expensive manner.

LXX.—*On the genuine East Indian Wootz Ore, Iron, and Steel, imported from India by* J. M. HEATH, *Esq. By the* EDITOR.

THE Editor having lately been kindly favoured by Mr. Heath with specimens of this ore, and of articles made of the cast-steel produced from it, and likewise with many particulars concerning these highly interesting subjects, he hastens to communicate them for the benefit of his readers.

The ore is a black magnetic oxide of iron, nearly of the nature of the long celebrated *oregrund*, or Swedish iron ore, from which our best cast-steel iron is, or properly speaking ought, to be made, only richer. It is a peroxide and protoxide of iron, frequently found in the form of regular octahedrons, and exceedingly rich in iron, and requiring no other addition to the silica generally accompanying it than limestone, to serve as a flux in its reduction to the metallic state.

The natives break the ore into coarse grains, and clean it perfectly, and smelt it in small furnaces, of the height of four feet, somewhat in the nature of our cupola furnaces, and, of course, with charcoal for fuel. They form the iron into bars of an inch broad, and half an inch thick, and cut it across nearly through, into squares fit for putting into their skittle-shaped melting pots, in order to convert it into cast-steel at once, by putting into the pots with it the wood of the *cassia auriculata*, or the tree which affords the catechu, employed in medicine as an astringent, and consisting of tannin. The pots, then being perfectly closed at their mouths with clay, are placed in small furnaces, the heat of which is excited by the goat-skin bellows usually employed by the natives; and they are continued therein until the conversion and fusion of the iron into cast-steel is at once effected.

The masses of steel possess the well known form of the cakes of *wootz* formerly imported into this country, and upon which so many experiments have been made by Sir Thomas Frankland, and by others, under the auspices of the late Sir Joseph Banks. It is made from a particular ore only, and not from masses of iron collected indiscriminately all over India, as has been stated by mistake.

Mr. Heath has imported a considerable quantity of the ore into this country, and has had it assayed by that experienced metallurgist, David Mushet, Esq., who has produced beautiful buttons of the reduced iron from it, by the addition of limestone only, and has ascertained the great richness of the ore. He has likewise had it analysed by Mr. Richard Phillips, and had its state of purity from admixture with other metals, and its perfect freedom from the presence of pyrites, phosphorus, arsenic, or the other injurious matters which commonly debase iron ores, correctly ascertained. He has also had iron made from the ore in the large way in this country, and has had it proved in a great variety of ways. Twisted gun-barrels have been made of it by Mr. Fullard, of Clerkenwell, a great test of its goodness; it has also been drawn into the finest wire; he had it rolled into hoop-iron; and also tried by a chain cable maker, when a cylindrical bolt, seven-eighths of an inch thick, was torn asunder by a power equal to seventeen tons and three quarters; he has had thick bars of it bent, until they tore asunder with a fibrous appearance, equal to that of the very best and justly celebrated Welsh iron; and, in fact, has proved its excellence in a great variety of other ways.

Finally, he has had the iron converted into blister-steel, and that melted into cast-steel, by the principal refiners in this country, and had the steel tilted into bars, rolled into sheets, and made into razors (the goodness of which the Editor can speak to from having used them); and also into pen-knives, fine scissars (the forging the rings in the bows of which latter articles alone sufficiently proves the perfect malleability of the steel), and a great variety of other articles; so that nothing now is wanting but the increased employment of it in this country, as a substitute, produced in one of our own colonies, for the Swedish steel-iron, now, in consequence of the very great demand for it, not to be obtained but at very high prices.

Mr. Heath had the iron also made into blister-steel, by cementation with charcoal in the usual manner, and which proved excellent in that state; as likewise into shear-steel, from which a great variety of articles, such as table-knives, &c. have been made.

Mr. Heath has also had an alloy of wootz and silver made by J. Thompson, Esq., of the London Company's steel works at Chelsea. He put together silver and steel in the proportion of one-four hundredth part of the former metal, but the result of the fusion proved, that it only imbibed one-five hundredth part of the silver, the remainder having separated entirely, and, in fact, had caused a division in the internal parts of the bar drawn out of the ingot; the silver appearing in the different fractures of its native white colour, and in a lamellated form.

The Editor has, at the request of Mr. Turrell, his engraver, put a specimen of Mr. Heath's wootz into his hands, with a view of having gravers' etching-needles, and dry-points, made of it, and thus testing its goodness in the use of those delicate articles. He has also given him a specimen of the above-mentioned alloy of wootz and silver, to prove in a similar manner.

The pen-knife has now been in constant use by the Editor for nearly three months, and its edge still retains its pristine goodness.

LXXI.—*On a method of making Cements for Terraces and Floors, and employing melted pitch to render them impermeable to water, and secure from the attacks of Frost.*

By CASSIMIR PUYMAURIN.

I SHALL not speak of the nature of the different lime cements hitherto known, as they have been fully described by various authors. I shall only observe, that a cement ought to be hard, solid, and impermeable to water. To obtain a hard and solid cement it has been necessary to employ different bodies, which, by their aggregation with lime dissolved in water, speedily absorb the superabundant moisture, and furnish to the particles of lime diffused throughout the cement the carbonic acid necessary for rendering it solid, and transforming it again into calcareous earth.

Vitrified lava, natural and artificial pozzolana, the scoriæ of furnaces, pounded bricks, bone-ashes, &c. have been the chief bases of all the cements hitherto made, and they have been obtained more or less solid. Cements composed in this manner have been attended with perfect success in the southern parts of Europe, little exposed to rain; they do not absorb the exterior moisture, and the frost has not power to dilate their pores, or to destroy their aggregation.

The cements of Italy, Africa, Spain, and other warm countries, unite all those qualities which can there be desired; but in our rainy countries, exposed also to very severe frosts, cements ought to possess a more essential quality than mere hardness or solidity, that is to say, impermeability. Cements composed of porous bodies cannot possess this quality, they being hard, and having the greatest solidity during summer; but the rains of autumn gradually penetrate to their interior parts, and reduce to powder that mass which a little before had the appearance of the greatest hardness.

The inventors of the most celebrated cements have seen their experiments fail, because they neglected this essential quality of impermeability. The interposition of a fatty body was long ago employed. Pliny and Vitruvius recommend the thick part of oil, and also oil itself; but these bodies employed alone can never answer the intended purpose. Oil forms with the lime of the cement a saponaceous body, soluble in water, and the thick part of oil contains a very large quantity of mucilage, which water dissolves and carries off.

To preserve the bottoms of cisterns, and to render them impermeable to water, resinous bodies have been employed, and particularly *liquid pitch* or *tar*. I have contrived that my cement should be covered with *boiling pitch*, as this resinous body penetrates its pores, and renders it impermeable to water. One inconvenience, however, appeared in the use of pitch, which was its property of becoming soft during the heat of summer. This inconvenience I remedied by sprinkling the pitch over with powder of lime; the lime combines with the pitch, and forms upon the cement an exterior stratum of a new cement, resembling the famous cement of the Romans, called *maltha*.

All the merit of my process consists, therefore, in having been the first to employ a resinous body, capable of penetrating and preserving cements, by filling up their pores, and thus rendering them impermeable to, and consequently insoluble in, water.

I shall here give the method which I generally employ in making my cements, but I must first observe, that there cannot be one general method of composing cements, as limestone and sand are not every where of the same qualities. The reader, therefore, must examine into the nature of the composition of the lime which he employs, as well as into the purity of the sand or other siliceous matters; he must then vary the proportions of the materials of his cement as may be necessary.

The methods of making cements for terraces, as generally given, require that the pozzolana, the pounded bricks, and the scoriæ be reduced to fine powder, and be sifted. This precaution is indeed necessary for those cements which are not to be covered with a resinous body, as their surfaces become thereby smoother and more compact, and less liable to be penetrated by moisture. But this advantage is more than balanced by the fissures and cracks occasioned by the shrinking of the cement in drying. This shrinking does not take place in the cements made according to my method, because I employ all the materials in the hard state, coarsely powdered in fragments of at least the size of a grain of wheat, and often as large as peas. These fragments broken in this manner thus present a great number of angles and cavities, into which the calcareous part of the cement penetrates, and thus forms as it were a kind of connected chain, which prevents those cracks and fissures from forming, which are so prejudicial to cements. The lime which I employed was made from hard and white limestone from the hill of Cazeres, in the department of the Upper Garonne: this lime dissolves with a sort of ebullition and a great heat, and after its disintegration, forms a smooth white paste with water, without any mixture of siliceous parts: it is susceptible of *swallowing*, as the masons here term it, a great deal of sand and other matters, but it has less strength in the open air than *meagre lime*, which being made from a marly stone, contains in its composition a great many hardened and vitrified argillaceous particles, which give it great strength when exposed to the open air and in water. This lime, called in that country *chaux de Bourret*, requires little sand, because the hardened and vitrified earthy parts which it contains form with it already an intimate mixture, or a kind of cement. This lime, therefore, when mixed with water, acquires in a little time the hardness of stone.

The lime I employed then was perfectly pure, and without any mixture of heterogenous parts, but it had no great solidity when exposed to the open air.

I found that a fifth part of lime was sufficient to give to a cement that binding quality necessary to envelop all the vitrified and siliceous parts of a calcareous composition, and consequently to give it the greatest solidity. Such is the process I employed to form on a roof which had been constructed for two hundred years, and the rafters of which were at a great distance apart, a terrace of forty square fathoms, which has already withstood four severe winters and our scorching summers, and still exists as perfect as ever.

One precaution I omitted to take, which embarrassed me a good deal, this was to pound the lime before it was employed. The lime, indeed, finally dissolves or slakes in water, but some of the stones composing it being less calcined than others, their nucleus does not dissolve, and they only become penetrated by the moisture. When these are blended with the gravel and other siliceous materials employed, at the end of some days the cement blisters and splits into small fragments, and bits of the lime which had not been dissolved are found in the state of lime slaked in the open air.

Take two measures of river pebbles, well washed, or fragments of bricks of the size of a nut, two of tiles and iron scales, coarsely pounded, one of river sand, perfectly well washed, and one of the lime of Cazeres, just fresh from the kiln, and pounded.

Form a circle with the sand, and throw into the hollow of it the lime, which has been well slaked, taking care to mix it thoroughly, and observe, that when the lime is well moistened, in order to slake it, leave it in that state for three hours, in order that the whole of the lime may be well slaked; then mix with the above mentioned lime and sand gradually, the river pebbles, the iron scales, and the tiles. This mortar must then be worked for half an hour, that every siliceous stone, fragment of tile, &c. may be well incorporated, and when the cement is almost finished, throw over it about a bushel of quick lime in powder. The mortar then becomes very difficult to be stirred. Two parts of cream of lime are then to be added.

Such is the manner in which I prepare cement. There are two methods of employing it, viz. either above a pavement of brick, or below it. The former appears, indeed, the most solid during the first year, whilst the other suffers the rain-water to filter through it; neverthless, in time, the latter acquires the most perfect solidity.

As time destroys the timber on which the mortar is laid, when a terrace is intended to be made upon a floor it must be previously coarsely covered over with a mixture of sand and clay with water; when this covering is dry, another, composed of mortar and pretty fat sand or loam, must be laid over it. There is no necessity for cutting the bricks even, on the contrary, the upper surface of them should even be roughened or notched with a chissel. This pavement must have a sufficient inclination given to it to cause the water to run off freely.

In the month of July, when the above mentioned two coverings are very dry, the cement, composed in the manner described, must be applied in bands of two feet in breadth; two workmen are sufficient to do it. This stratum of cement ought to be from two inches and a half to three inches in thickness, the covering on which it is laid ought to be previously moistened with the milk of quick lime, and the cement must be pressed down closely upon it with the trowel, taking care also to beat it with the sharp edge of the instrument. It is then smoothened with the back of the trowel, slightly moistened. The surface of the cement must be lastly again pressed down, in order to bury the coarser parts of the composition, and render the whole smooth. When the first band is finished, the workman proceeds to lay a second in the same manner, and the two bands must be carefully united to prevent their separation.

This cement soon dries, and at the end of an hour can sustain a strong pressure. It must, however, be left for seven or eight days, after which time the surface of it is to be slightly moistened, and be then beaten and smoothened by means of flat stones. This last precaution is essentially necessary, and the solidity of the cement will depend on the care with which it has been performed. When the terrace has been constructed in this manner the aggregation of the cement becomes stronger, and its pores are smaller, and less numerous.

In order that the terrace may succeed perfectly, it must be made during the great heats in July, in order that the superabundant water may evaporate, and that it may become perfectly dry before the autumnal rains. At the end of August boil pitch, such as that used for ships, and spread it hot over the cement by means of large brushes. As this coating would render the terrace not fit to be touched during summer, this inconvenience may be remedied in the following manner :—Take lime, slaked in the open air, and reduced to fine powder, and having sprinkled it over the pitch, remove by means of a broom, the superfluous part of the lime which does not adhere to it. The lime combining with the pitch will form with it a very thin stratum of a cement, similar, as above mentioned, to the *maltha* of the Romans. At the beginning of October, a second stratum of pitch and lime must be laid on.

The second method of employing the cement is to place it immediately over the stratum of brick and clay, and then to cover it with a pavement of brick, mortar, and sand. I have two terraces, fifteen fathoms in length and one and a half in breadth, which appear to me to have the greatest solidity. They are, indeed, not so beautiful as those where the cement covers the brick, but they stand every kind of friction or pressure.

After making a stratum of clay and sand, spread over it a stratum of cement, four inches in thickness, well beaten, and add pebbles somewhat larger than those employed in the preceding cement, and also increase the quantity of lime in proportion; the cement must then be beaten with clubs like those used for smoothening the walks in the neighbourhood of Paris. It is then to be left to dry for a month, after which the surface of it must be moistened with milk of lime, and the bricks are to be laid with good lime and sand.

It is not necessary that these bricks should be dressed. I have observed, that by cutting them their strength is lessened, as it destroys their semi-vitrified surfaces, as nothing then remains below them but earth, which is soon penetrated by moisture, and easily destroyed by frost; so care must be taken to fill up the joints between the bricks with good mortar, which must be pressed in them and smoothed by the trowel, and be then well coated with pitch.

Terraces constructed in this manner suffer the water for some time to filter through them in small quantities. This water, however, becoming charged with calcareous particles, stops up the pores in the cement, no more filtration then takes place, and terraces of this kind have the greatest solidity, and are exceedingly cheap. This cement may be employed with advantage for the interiors of apartments; it may also supply the place of pavements of dressed bricks, and costs two-thirds less.

It must be spread for this use over a pavement of rough bricks, or bricks picked by an instrument to the thickness of an inch, or rather more. The pebbles may be omitted, and their place supplied by fragments of tiles and iron scales coarsely pounded, it is then to be beaten down and pressed with flat stones; but before it is painted, it must be suffered to dry for a month. It is painted and waxed in the same manner as brick pavements or floors.

Such are the details of the cements I have employed, and which have been attended with complete success. But I shall here repeat, that the proportions must be varied, according to the greater or lesser purity of the lime and other materials employed, and that the application of the pitch is merely to prevent the entrance of water, and the consequent destruction of the cement by frost.

LXXII.—*Remarks upon the Construction of Pumps for Raising Water. By Dr.* THOMAS P. JONES, *Editor of the Franklin Journal.*

WE have, at different times, received communications on the construction of pumps and other machines for raising water, which have often served to manifest a deficiency in, or a total want of, knowledge of their action. Among the numerous errors which prevail upon this subject, the idea, that the pressure of the atmosphere diminishes the power necessary to raise water in the common pump, appears to be the most general. We have now before us a letter received from a gentleman in South Carolina, some weeks since, whose plan is to raise water from deep wells, say of ninety feet, by successive pumps. He proposes, that a pump of thirty feet in length shall be placed at the bottom of the well to raise the water into a reservoir fixed to receive it, near the head of this pump; that the bottom of a second pump shall stand in this reservoir, and that a third be similarly arranged to elevate the water to the surface of the earth; and that the rods, from these pumps, be of sufficient length to be attached to a common handle at top, to work simultaneously. Three pumps, so arranged, will, he calculates, save, at least, the necessity of lifting a column of water of three times twenty-eight, or eighty-four feet in length, and that the labour, therefore, would be so reduced, that the weight of the rods, the friction, and a column of water, of six feet in height, would alone require to be raised.

This may serve as a fair example of numerous proposed improvements, coming, in many instances, from persons not deficient in general intelligence; the subject is, therefore, worthy of particular attention, as such errors frequently lead to much loss, both in time and money. We will, hereafter, endeavour to place it in a clear light, but, at present, shall only state such facts and principles, as we think can be made plain to every attentive reader.

To the correspondent alluded to, we will say, that his plan, although novel to him, is not so to those conversant with the subject. Pumps made in the way proposed, have been constructed, and are figured in books. To all those who imagine that in pumping water they can derive any aid from atmospheric pressure, we will say that they are altogether mistaken. We cannot, by any contrivance, or by any construction of our machinery, raise a hundred pounds of water to the height of ten feet, without the application of as much power as is requisite to raise a stone of the same weight, to the same height; the *atmosphere* will assist us just as little in the one case as in the other, and if we wish to raise double the quantity to the same height, or the same quantity to double the height, we must employ double the power, or its equivalent, double the time.

The three pumps, made as above stated, were so made, not to lessen the power required to raise the water, but to obviate some practical difficulties. A pump-tree of wood, ninety or one hundred feet in length, is very liable to burst by the weight of the column of water contained in it; and, from a similar cause, the valves are raised with difficulty; by dividing the pump into three parts, there will be a corresponding dimunition in this pressure; but there will also be a greatly increased load from the amount of pump-rods, and also an increased number of valves to open, and to become deranged. We did not, however, set out to discuss the merit of this kind of pump, or any other, but to furnish some hydraulic didactics.

Something may undoubtedly be accomplished in the improvement of pumps; but we are just as well prepared to credit the accounts of the discovery of the perpetual motion, as those which are so frequently given of hydraulic machines enabling two or three men to perform as much work as double that number by the machinery now known. It is certainly not possible to procure, with the same power, one-third more water than we now can with our best pumps. Nearly or quite all that is to be hoped for is to lessen friction, to remove obstructions to the free passage of the water through the valves, and to cause them to open and close without loss of time or water.

With regard to the action of the atmosphere, we will merely remark, that we sometimes, and indeed, generally, construct our pumps so as to bring it into operation; but such is the nature of the aid which we receive from it, that for every pound of water which it forces up by its pressure, we must force a pound of air to the same height; and if we choose to lengthen our pump-rod, so as to allow the piston to be below the surface of the water in the well, we may dismiss the atmosphere from our service; and were it not for the necessity of breathing whilst we are pumping, we should not, by so doing, lessen the facility with which water would be obtained.

LXXIII.—*On the great Tenacity of Life possessed by various Insects; and on the necessity of Entomologists adopting better means of speedily destroying it, and of preserving their Specimens from injury.* By THOMAS CARPENTER, Esq.

DEAR SIR, *London, May* 1, 1828.

THE apparatus or curious set of instruments described by you, in page 97 of your present volume, and which I took out of a groove in the proboscis of a fly, of the genus *Tabanus*, that had attached itself to my horse, for the purpose of sucking its blood, reminds me of the great tenacity of life in that and numerous other insects; and which I beg leave to detail to you as curious facts in the economy of nature.

The fly above-mentioned I killed, as I thought, by crushing it between my fingers, on removing it from the skin of the horse, and put it into a small pill-box, for the purpose of minutely examining it under the microscope on my return home. On opening the box, however, some hours afterwards, I found the insect, although in that mutilated state, still living, and crawling about.

A friend once brought me a large moth, which he had for some days confined in a small box. The insect, in fluttering about, had completely destroyed its beauty, and being unfit for my cabinet, I proceeded to put it to death in the most speedy way, as I then conceived, viz. by separating its head from its body with a pair of scissars, and then put it by within the box for dissection. In taking it out about eight hours afterwards, I was, however, much surprised at seeing its proboscis still expand and contract alternately, and its wings repeatedly flutter.

A very singular circumstance respecting the sting of a wasp also fell under my own observation. I found in the footpath a wasp, which had been trod upon, and was apparently dead, as it was completely crushed flat, and almost into separate pieces; this I kept during the whole day, and at night I proceeded to take out its sting; but which, to my great surprise, protruded of itself, and kept moving about in various directions, endeavouring, as it were, to pierce the fingers which pressed on the part, and this it continued to do as often as my fingers pressed it. On the same day, in the early part of the morning, I found two beetles, apparently dead, as they were trod to pieces, and their intestines were forced out. I plucked off the heads from these insects, and put them into a pill-box. I was, however, indeed much surprised, on looking at the heads twelve hours afterwards, to find their horns in motion, and their jaws moving to and fro, the mouth also frequently opening and shutting.

These different facts show how very tenacious of life insects are; and that they must still possess feeling when in states that would render life extinct in ourselves. I could readily enumerate more than a hundred other examples of a similar nature, but I trust that these will be quite sufficient to impress upon the minds of entomologists the necessity of putting those insects they wish to preserve in their cabinets to as speedy a death as possible. My method of doing this is simply as follows. The whole of the beetle tribe I put into a bason, and pour *boiling* water upon them; this method kills them instantly, and does not destroy any of their fine scales or colours; on the contrary, it cleans them from any dirt or other extraneous matters which sometimes attach themselves to their wing-cases. The most splendid curculios I always clean in this manner. The diamond beetles, for instance, when exceedingly dusty and dirty, I uniformly plunge into hot water, and wash with a camel's hair brush. It is true that when first taken out of the water, they appear black, and with all their colours destroyed; but place them on a sheet of blotting paper, in order to absorb the moisture, and in a short time the colours return in all their pristine splendour.

When an entomologist looks over his cabinet, at the insects he has killed in this quick manner, it must be gratifying to his feelings to know that he has not added an unnecessary pang to any individual in it.

Moths, butterflies, dragon-flies, and other large insects, may be killed by holding their wings close together, between the thumb and finger, and then dipping their heads and bodies into boiling water. The plumage on their wings will thus be less injured than by following the ordinary barbarous practice of passing a pin through their bodies, and keeping their wings from fluttering by means of card braces. What trifling defects the water may produce, on the bodies being immersed in it, will not be noticed in the cabinet, because the wings will cover the greatest part of their bodies.

It is the custom of many collectors, who are nevertheless humane and well disposed persons in a general sense, to thus pin every insect they meet with, and then to place them in what they term a store or collecting box, and to leave them in that state until they have leisure to examine and set them. The time which elapses, however, before this is done, is frequently a week or ten days; at the end of which time, many of these impaled objects are still seen writhing and fluttering about; surely this cannot be pleasing in the sight of Him who made these insects as well as ourselves! If then the beauties of nature must be possessed by us, let us, when we deprive them of life, endeavour to do it in the most speedy manner possible.

Other collectors also place all the beetles they collect in the course of the day, in one common box, and leave them in that state for several days; by which means, however, they lose many rare species, and thus defeat their object; for thus are friends and foes indiscriminately put together into one common receptacle, and the consequence is, that when the collector opens the box, he finds the greatest part of them in such a mangled state, being partly devoured by some of the others, that very few remain fit for his cabinet.

I have nevertheless the pleasure of being acquainted with many entomologists, who possess feelings towards the insect tribes that do them credit. They uniformly take out with them, on their excursions, numerous small pill boxes; and when they capture any insect destined for their cabinet, they place it in a box alone, never putting two into the same box; by which means, a twofold purpose is answered, viz. the beauty of the insect is preserved, and every part of it kept in a perfect state. These are afterwards put to death in the manner I have above described.

It must no doubt have occurred to you, as well as to many of your readers, that the mind in its natural state is prone to exercises of cruelty. For instance, a boy observes a bird perched on a tree, singing to cheer its partner during the act of incubation; the little urchin instinctively snatches up the first stone he can seize, and throws it at the poor unoffending bird. Others will, out of mere wanton sport torture flies, moths, &c. Many parents will even instruct their children in the art of torturing them, witness that cruel spectacle, considered by many as exceedingly amusing, of passing a pin through the appendage to the body of the cockchafer; these, and many other refinements in cruelty, might be obviated, if parents and teachers of children would only take pains in pointing out to them, in their early stages of life, that all God's creatures, from the highest to the lowest, were made by him to perform some important duty in the scale of creation: for of this we may rest assured, that nothing was ever created in vain. I would therefore submit the propriety of not only giving them such instruction as would tend to excite proper feelings in them towards the inferior orders of animals, but let them also learn to recite such extracts from our standard works, as would eventually produce a proper change in their moral conduct. I am, dear sir, yours truly,

To T. Gill, *Esq.* THOMAS CARPENTER.

LXXIV.—*On the East Indian method of preparing the Catechu, or Terra-Japonica. By* FRANCIS BUCHANAN, *M.D.*[*]

"IN this part of Kankana, a little *cut*, *catechu*, or *terra japonica*, is made by some poor people, who gave me the following account of the process. The tree or *mimosa catechu* is called here *keiri*, and grows spontaneously on all the hills of Kankana, but no where else in the peninsula that I observed. It is felled at any season, and, the white wood being removed, the heart is cut into bits, and put, with one half the quantity of water, by measure, into a round-bellied earthen pot. It is then boiled for about three hours; and when the decoction has become ropy, it is decanted. The same quantity of water is again added and boiled, until it becomes ropy, when it is decanted, and a third water is also given. This extracts all the substance from the wood. The three decoctions are then mixed, and next morning boiled in small pots, until the extract becomes thick like tar. It is afterwards allowed to remain in the pots for two days, and then has become so hard that it will not run. Some husks of rice are then spread on the ground, and the inspissated juice is formed into balls, about the size of oranges, which are placed on the husks, or on leaves, and laid seven days in the shade to dry, or, in the rainy season, twice that length of time, and are then fit for sale. Merchants who live above the Ghats, advance the whole price four months before the time of delivery, and give two rupees for a maund of forty cutcha seers of twenty-four rupees weight; that is, for a hundred weight, nine rupees and eighty-nine-one hundredths, or nearly one pound sterling. The merchants who purchase reside chiefly at Darwara, Shanore, and other parts in that neighbourhood, and are those who supply the greater part of the peninsula with this article, which among the natives is in universal use. Their greatest supply comes from that part of Kankana which is subject to the Marattahs. The encouragement of this manufacture in British Kankana seems to merit attention. The tree is exactly the same with that I found used for the like purpose in the dominions of Ava, and does not agree very well with the descriptions in the *Supplementum Plantarum* of the younger Linnæus, nor in Dr. Roxburgh's manuscripts."

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[*] From his "Journey from Madras through Mysore, Canara, and Malabar.

LXXV.—*On the cultivation of the Betel-Nut, Betel-Leaf, Black Pepper, Cardamom, and Plantain Gardens at Sersi, in the East Indies. By* FRANCIS BUCHANAN, *M.D.*[*]

"15th March.—I continued at Sersi, taking an account of the state of the country, as an example of the western parts of Soonda, in which the cultivation of gardens is the chief object of the farmer.

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[*] From the same work as the former article.

"In these gardens are raised promiscuously, betel-nut and betel-leaf, black pepper, cardamons, and plantains. A great part of the ground formerly planted has now become waste, and there is some fit for the purpose that would appear never to have been cultivated; but it is only a small proportion of the whole country that can be employed in this way, and that is chiefly in the neighbourhood of the Ghats. Towards the eastern side of the province there are very few gardens. The situation required is a low narrow valley, with its head to the west, and opening toward the east; so that the hills by which it is bounded may defend it from the west and south sun. To add to the shelter, the hills in these directions must also belong to the garden, and must be covered with trees, which are annually pruned, to procure branches that serve as manure. At all seasons the garden must command a supply of water. This commonly is obtained from springs, which are numerous in this country at the head of almost every little valley. The water of these springs is collected in a small pond or reservoir, from whence it can at pleasure be let out by a channel which is conducted along the upper side of the garden. Water is also procured by forming channels from the small rivulets with which the country abounds. Some rich men fill up the whole bed of one of these rivulets, and form their plantation in the place where it was. They have thus at its upper end a reservoir formed of the remaining part of the old channel, and by one side of the garden they draw a canal to carry off the superfluous water. This incurs a considerable expense, not only in fitting up the channel, but in giving the reservoir and canal a strength sufficient to resist the torrents of the rainy season. The best soil for these gardens is the *cagadali*, a red mould containing very small stones. I observe, however, that all kinds of soil are used. The prevalent one throughout the country is a light coloured loam, of great depth.

"The first step in the process of making a new garden, is to surround it with a ditch, to keep off the torrents which descend from the hills. The garden is then levelled with the hoe, and the whole is formed into beds, about twenty feet wide, by drains, which are parallel to each other, and run in the direction of the length of the valley, or nearly east and west. These drains are intended to carry away water that at all seasons springs up from the soil wherever it is opened. The soil where this abounds is reckoned by far the best; but the water itself is very pernicious, and nothing would grow unless it were carefully removed by the drains. These are about a foot broad, and, according to the natural moisture of the soil, are from a foot to eighteen inches deep. At the same time must be formed the reservoir or canal for giving the supply of water, with the channels in which it is to run. The principal channel runs at the head of the garden, and crosses the direction of the drains. From this a small channel leads between every two drains, in the centre of each bed*. Such is the disposition of some of the gardens that I examined; but, according to the various declivities in different gardens, it must be varied considerably. The season for performing this labour is during the two months which precede the autumnal equinox.

"In the month following the autumnal equinox, young plantain trees are set in rows, within two feet of each side of the drains, and at the distance of twelve feet from each other. If possible, the whole garden should then be covered with branches of the *nelli (phyllanthus emblica)*; at any rate, some must be put near each young plantain tree; and at the same time the centre channel of each bed must be raised a cubit high, with earth brought from the neighbouring hills. When the rainy season is over, the earth is spread upon the bed, the channel is formed anew, and every fifteen days water is given once. In the operation of watering, the channel is first filled, and then with a pot or scoop some water is thrown on the roots of the trees.

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* See fig. 2 of plate VII. in our last number.

"In the same season of the second year, a pit, of a cubit square, and of the same depth, is made between every two plantain trees. In each pit is placed a young areca, which is taken up from the seed-bed with much earth adhering to its root. The pit is filled with fresh earth, which is trampled down by the foot; so that one half of the pit becomes empty, and is afterwards filled with the leaves of the *emblica*. At the same period of every even year, that is, the second, fourth, sixth, and so forth, the channels of every bed must be filled with fresh earth. In the month preceding the winter solstice, the beds must be levelled, and, new channels having been formed, the trees must be watered once every fifteen days. In the second month afterwards, the beds must be hoed, and each tree manured with rotten dung taken from the cow-house, where the litter used has been either fresh leaves or dry grass. Above this are spread the small branches and leaves of any kind of trees, and toward the root of every Areca a quantity of these is heaped up. In the month preceding the summer solstice, the plantain leaves are removed, and young shoots are found to have come from the nuts. In the second month afterwards, leaves of the emblica are spread between the young plants. In the month preceding the vernal equinox, they get a little dung. In the dry season they are watered once in from four to eight days, according to the nature of the soil. They are not removed till they are going to be finally planted in the garden, which is done in their fifth year. They are then estimated worth one silver fanam a hundred, five fanams and a half going to the rupee; but they are seldom sold, any man lending to his neighbour when he may be in want of a few.

"The crop season of an areca garden continues from two months before, till one after, the winter solstice. The bunches are cut as they approach to ripeness, for the ripe nut is of no use except for seed. The husk is removed with a knife. A decoction is then made with a few nuts, a little *chunam* (ashes of the bark of the *chuncoa muttia.* Birch. MSS.), and some of the bark of the *honay*, or *pterocarpus santolinus.* These are bruised together, and are boiled six hours in water. A quantity of the nut cleared from the husk is then put in a pot, and into this the decoction is poured, until it rises above the nuts, which are then boiled till the eyes separate. They are now put upon a strainer of mats supported on posts, and dried six days in the sun. At night they are covered with a mat. In this country the betel-nut is never cut, but is sold entire, and is called red betel. Any nuts of a bunch that have become too ripe before it was cut, are picked out and kept separate. Their husks are removed, and they are dried in the sun without boiling. These are called raw betel, and sell much lower than the other kind.

From the month preceding the winter solstice, to that following the vernal equinox, the leaves of the areca fall off. Each is accompanied by its broad, leathery, membraneous petiole; which, when they are young, form collectively a green smooth body at the top of the stem. These membranes are cut off, and carefully preserved. They are about three feet long, and a cubit broad; and, in the rainy season, are used to make covers for the young bunches or *spadices.* In the month following the summer solstice, a man mounts the areca, and above every bunch fixes a cover, so as entirely to keep off the rain. Some of the trees are so tall and slender, that they cannot bear the weight of the operator, and thus are deprived of covers. On these the bunches produce only from five to a hundred nuts, while two hundred nuts are reckoned the average produce of a covered bunch, and some bring five hundred to maturity. Each tree commonly yields two good bunches, or three small ones. The average produce is said to be one maund, or seventy-two seers of boiled nut from fifty trees, or nine thousand one hundred and forty-eight-ten thousandths parts of a pound. A particular set of men are employed to cover the bunches, and cut down the fruit. At each time they get two rupees for every thousand bunches, and are very dexterous. Round their ancles, and under their soles, they fix a rope made of plantain stems, and thus unite their feet, which are then placed against the stem, and drawn up together, while the climber holds on with his hands. Having placed the rope and his feet firm against the stem, he first moves up one hand and then the other, and afterwards draws up his feet again. In this manner he reaches the top of one tree, where he secures himself by taking a round turn with a rope, which he carries up in his hand. One end of this rope is tied to the middle of a short stick, upon which the man seats himself, and performs his labour, drawing up whatever he wants from an attendant below, by means of a line that he has affixed to his girdle. When he has done with one tree, he unties his seat, secures it round his neck, and swings the tree backwards and forwards till he can reach another, upon which he then throws himself, and again makes fast his seat. He thus passes over the whole garden without ever coming to the ground. The trees that, from being too tall and slender, are unable to support a man's weight, have their fruit gathered by being pulled towards a neighbouring tree by means of a hook. The cultivators seem to underrate the produce very much.

“When the betel-nut palm is thirteen years old, the garden is planted either with black pepper, or betel-leaf vines, which climb upon the areca. The pepper is of three kinds. The *cari maynasu* is the most productive, but requires a *cagadali* soil. In this, the produce of a good tree covered with *cari maynasu*, is reckoned five seers of cured pepper, or a small fraction more than three pounds. The *sámbara* and *arsina gutti* thrive very well on *arsina munnu*, or a light coloured soil; but the first produces only one seer, and the latter two. The quality of all the kinds is the same. In the month following the vernal equinox, four cuttings of the pepper vine, each a cubit and a half in length, are taken for every areca. One of their ends is buried five or six inches in the ground, the other is tied to the stem of its supporter. The vine requires no farther trouble, but tying its bunches up once a year in the month preceding the summer solstice. It bears in six or seven years, and lives about twenty-five; so that one areca requires three or four sets of vines. The crop season is during the two months which precede the vernal equinox. The fruit is collected by means of ladders; and a man does not collect and cure in a day more than five seers, or three pounds. The pepper, as usual, is gathered when the grains are full grown, but not ripe. Here the *amenta* are gathered into a heap, which stands in the house, and there they are kept three days. They are then rubbed with the foot; and the grains, having been separated from all other matters, are then fit for sale.

"A little white pepper is made by allowing the berries to ripen. The bunches having been kept three days in the house, are washed and bruised in a basket with the hand, till all the amenta and pulp are removed. The seed is then dried five days, and is fit for sale. It is twice as dear as black pepper, but the demand for it is very small, for it is only used as a medicine.

The betel-leaf is cultivated exactly like the pepper, and lives the same length of time. In this country, the *nagwally*, or female plant, for it is *dioecious*, is that chiefly used; but the *umbadi*, or male, may also be found. Here both frequently produce fructification, which I have not seen any where else. A thousand leaves of the nagawally sell for eight *dubs*, while the same number of leaves of the umbadi bring only one-fourth part of that sum.

"Whenever the betel and pepper vines have fairly taken root, the greater part of the plantain trees are removed.

"The cardamoms *(amomum repens)* are propagated entirely by the cuttings of the root, and spread in clumps, exactly like the plantain tree, or musa. In the month following the autumnal equinox, a cluster of from three to five stems, with the roots adhering, are separated from a bunch, and planted in the same row, one between every two betel-nut palms, in the spot from whence a plantain tree has been removed. The ground around the cardamom is manured with *nelli (emblica)* leaves. In the third year, about the autumnal equinox, it produces fruit. The capsules are gathered as they ripen, and are dried four days on a mat, which during the day is supported on four sticks, and exposed to the sun, but at night is taken into the house. They are then fit for sale. Whenever the whole fruit has been removed, the plants are then raised, and all the superfluous stems and roots having been separated, they are set again; but care is taken never to set a plant in the same spot from whence it was raised, a change in this respect being considered as necessary. Next year these plants give no fruit, but in the year following yield capsules again, as at first. After transplantation, the old stems die, and new ones spring from the roots. Each cluster produces from one quarter to one seer weight of cardomoms, or from eleven-one hundredths to six-tenths of a pound.

LXXVI.—*On the English Method of Gilding on Metal Buttons, &c.*

To prepare the Amalgam.—A quantity of mercury is put either into a crucible, or into an iron ladle, which has been previously lined with a coating of pipe-clay, and exposed to heat till it begins to pass off in fumes on becoming volatilised. The gold to be mixed with it to form the amalgam should be previously granulated, and be heated red-hot, when it should be added to the mercury, and be well stirred about with an iron rod till it is perfectly amalgamated with the mercury. If there should be any superfluous mercury, it may be separated by squeezing it through a clean soft shamoy skin, and the remaining amalgam should then have a consistence resembling that of butter, and contain about three parts of mercury to one of gold.

On Gilding with the Amalgam.—The metal articles, such as buttons, &c. to be gilt must be well cleaned on their surfaces, by boiling them in a very dilute nitric acid. A quantity of gilders' *aquafortis* is then poured into an earthen vessel, and mercury put therein; when a sufficient quantity of the mercury is dissolved, the articles to be gilt must be put into the solution, and be stirred about with a brush till they become white. This operation is termed *quicking*; but as during the quicking by this mode a great quantity of noxious nitrous acid fumes continually arose, which proved highly prejudicial to the health of the workmen, so another method has been adopted, by which, in a great measure, that evil is avoided. They now dissolve the mercury in a bottle containing the aquafortis, and leave it in the open air during the solution, so that the noxious vapours escape into the atmosphere. They then pour a little of this solution into a bason, and, with a brush dipped therein, wipe over the surfaces of the metal articles to be gilt, which immediately, as by the other method, become *quicked*, or coated with mercury. The amalgam is now applied to them by one of the following methods, viz.: first, by proportioning the quantity of the amalgam to the number of the articles to be gilt, and putting them together into a large cap made of felt on purpose for this business, they work or stir them about continually with a large soft brush, made of bristles, like a painter's brush, till the amalgam is uniformly spread or diffused over their surfaces, or else they apply a portion of the amalgam, taken up by means of a blade of copper, affixed in a wooden haft or handle upon one part of the object to be gilt, and then spread or diffuse it over its surface, by working it about with a harder brush. The work thus treated is put into a broad, shallow, iron pan, having a wooden handle to it, and exposed to a gentle degree of heat over a fire of coke; when it becomes hot it is frequently returned into the cap, and the amalgam again spread over the surfaces of the articles, with the large painter's brush, and again heated in the iron pan, which is also kept in continual agitation, so as to shake up the buttons, &c. and cause them to be more uniformly heated, and to prevent the irregular dissipation of mercury, until at length it is entirely volatilised by a repetition of the heating, and the gold is attached to the surfaces of the metal articles. These gilt surfaces are then well cleaned by rubbing them with wire scratch brushes, and artists afterwards exalt the colour of the gold by the application of various compositions. This part of the process is called *colouring*. I have selected the following, which are as good as can be obtained for the purpose.

A Wax to exalt the Colour of Red Gold.—To four ounces of yellow melted bees-wax add, in fine powder, one ounce and a half of red ochre, one ounce and a half of verdigrease, calcined till it yields no fumes, and half an ounce of calcined borax, mix them well together. It is necessary to calcine the verdigrease, or else by the heat applied in burning off the wax from the surfaces of the gilt works coated with it, the acetic acid in the verdigrease would be so concentrated, that it would corrode these surfaces, and make them appear speckled.

To exalt the Colour of Green Gold.—Take saltpetre one ounce ten dwts., sal-ammoniac, once ounce four dwts., and verdigrease eighteen dwts., and dissolve a portion of the mixture in water, as occasion requires.

To exalt the Colour of Yellow Gold.—Take saltpetre six ounces, green copperas two ounces, white vitriol and alum of each one ounce. If the colour be wanted redder, a small portion of blue vitriol must be added. These are also to be dissolved in water, as wanted.

These two last compositions must be applied to the surfaces of the gilt works either with a pencil, or by dipping them into them; a proper degree of heat must then be used to cause them to assume a black colour, when they must be quenched or cooled either in vinegar or water.

On Gilding in different Colours.—The principal colours of gold for gilding are red, green, or yellow. These should be kept in different amalgams; that part of the work to be gilt, which is to remain of the first colour employed, is to be *stopped off*, or defended, with a composition of chalk and glue brushed over it; the variety of colour required is then produced by gilding the unstopped parts with the proper amalgam, applied in the usual mode of gilding.

Sometimes the amalgam is applied to the surface to be gilt without any previous application of the mercurial solution, by spreading the amalgam over it by the help of nitric acid; but this method, nevertheless, depends upon the same principle as employing the mercurial solution.

LXXVII.—*On various Compound Metals**.

Standard of British Gold Coin.—This standard by law is, for every pound weight, to contain eleven-twelfths of pure gold and one-twelfth of alloy.

Standard Silver.—Eleven ounces two pennyweights of fine silver, and eighteen pennyweights of alloy in a pound troy.

Gold Solder.—Pure gold twelve pennyweights; pure silver two pennyweights; and copper four pennyweights.

Silver Solder for Jewellers.—Nineteen pennyweights of fine silver; copper one pennyweight; and of brass ten pennyweights.

Silver Solder for Plating with.—Ten pennyweights of brass and one ounce of pure silver.

Ring Gold.—Fine copper six pennyweights and twelve grains, three pennyweights and sixteen grains of fine silver, to one ounce five pennyweights of gold coin. This is worth about 3*l.* per ounce.

Gold from 35*s.* *to* 40*s.* *per ounce.*—Eight ounces eight pennyweights of fine copper, ten pennyweights of fine silver, to one ounce of gold coin.

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* From Richardson's *Chemical Principles of the Metallic Arts.*

Manheim Gold, or Similor.—Three ounces and a half of copper, one ounce and a half of brass, and fifteen grains of pure tin.

Pinchbeck.—One ounce of brass, one ounce and a half or two ounces of copper, fused together under a coat of charcoal dust.

Prince's Metal.—Three ounces of copper and one ounce of zinc, or eight ounces of brass and one ounce of zinc.

Bell Metal.—One hundred parts of copper mixed with from twenty to twenty-five parts of tin.

Gun Metal.—One hundred pounds of copper, and twelve pounds of tin, either with or without a little brass.

Best Hard White Metal for Buttons.—One pound of Bristol brass, two ounces of zinc, and one ounce of block tin.

Common Hard White Metal.—One pound of brass, one ounce and a half of zinc, and half an ounce of tin.

Bath Metal.—One pound of brass, and four ounces and a half of zinc.

A White Metal.—Two pounds of regulus of antimony, eight ounces of brass, and ten ounces of tin.

Hard Solder.—Two pounds of copper to one pound of tin.

Soft Solder.—Two-thirds of tin and one-third of lead.

Hard Pewter.—Twelve ounces of tin, one ounce of regulus of antimony, and two drachms of copper.

Tutania.—Eight ounces of brass, two pounds of regulus of antimony, and seven ounces of tin.

A Metal for Speculums or Mirrors.—Copper thirty-two parts, tin fifteen, brass one, silver one, and arsenic one.

LXXVIII.—*On Plating Copper.—On separating the Silver from it, and on Assaying it.*[*]

The principal difficulties in plating copper ingots for rolling, are to bring the surfaces of the copper and silver into fusion at the same time, and to prevent the copper from oxiding or scaling, for which purpose fluxes are used. The flat surface of the copper ingot, on which the silver is to be fixed, must be made true by filing it, and should be left rough from the file; the ingot of silver is first annealed, and afterwards *pickled* in weak muriatic acid; it is then planished, and afterwards scraped on the surface which is to be fitted on the copper. These prepared surfaces are then either wetted with a solution of borax in water, or sprinkled over with finely powdered borax itself, and must be then confined in close contact with each other by binding wire. When they are exposed to a sufficient degree of heat, the flux causes the two surfaces of silver and copper to fuse at the same time, and after they are become cold, they are found to be firmly united, and may be passed through the flatting mills, in order to reduce them to the proper thickness for use.

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[*] From the same work.

To strip or remove the silver from Plated Copper.—This process is employed in order to recover the silver from the scraps of such plated copper as has been rolled down to fit sizes for making buttons, toys, &c. For this purpose a menstruum is composed of a mixture of three pounds of sulphuric acid, one ounce and a half of nitre, and one pound of water. The plated metal is boiled in this menstruum until the silver is dissolved, and which is afterwards recovered from the solution by throwing into it common salt dissolved in water, which precipitates the silver.

To make an Assay of Plated Metal.—Take a determinate quantity of the plated metal, put it into an earthen vessel, with a sufficient quantity of the above menstruum, and place it in a gentle heat. When the silver is stripped or dissolved it must be collected with a solution of common salt; the precipitate must be tested off with pure lead in a cupelling furnace under a muffle, and the estimate made according to the product of silver so obtained.

LXXIX.—*On the Colours obtained from the Metallic Oxides, and fixed by fusion on different vitreous bodies; abstracted from an essay on that subject. By* ALEXANDER BROGNIART, *director of the National Manufactory of Porcelain at Sevres, in France*[*].

THE art of employing metallic oxides for colouring by fusion different vitreous matters, is of very great antiquity: every body knows that the antients manufactured coloured glass and enamel, and that this art was practised in particular by the Egyptians, the first people who in this manner imitated precious stones.

The practice of this art in modern times has been carried to a high degree of perfection; but the theory has been neglected: it is almost the only one of the chemical arts in which no attempt has yet been made to apply the new principles of that science.

The very numerous works which treat on the method of preparing and applying vitrifiable metallic colours, either contain no theory, and consequently no general principles, or give only explanations founded on hypothesis, often ridiculous, which formerly composed the theory of chemistry.

I have thought it might be of utility to the arts, and that it was the duty of the national manufactory of Sevres, to make known the pretended secret of the composition of those porcelain colours which are unalterable in the fire.

My object is not to give a detailed account of the exact composition of all the vitrifiable colours; such a labour cannot be the subject of a single memoir.

It is well known that all vitrifiable colours have for their basis metallic oxides; but all the metallic oxides are not proper for this purpose; besides, as they are not vitrifiable by themselves, they can scarcely ever be employed alone.

Highly volatile oxides, and those which adhere little to the great quantity of oxygen they contain, either cannot be employed in any manner, as the oxide of mercury and that of arsenic, or are employed only as agents. The colour they present cannot be depended on, since they must lose it in the slightest heat, by losing a part of their oxygen; such are the puce-coloured and red oxides of lead, the yellow oxide of gold, &c.

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[*] From the *Franklin Journal.*

Oxides in which the proportion of oxygen are susceptible of varying with too much facility, are rarely employed: the oxide of iron, though black, is never employed for that colour; and the green oxide of copper is, under many circumstances, very uncertain.

I have said that alone oxides are not susceptible of fusion; however, as they are destined to be applied in thin strata on vitrifiable substances, they may be attached to them by a violent heat; but, except the oxides of lead and bismuth, they would give only dull colours. The violent heat, often necessary to fix them, would change or totally destroy the colours. A flux then is added to all metallic oxides.

This flux is glass of lead, silex, glass of borax, or mixtures of them.

Its general effect is to give splendour to the colours after their fusion; to fix them on the article which is painted, by promoting, more or less, the softening af its surface; to envelop the metallic oxides, and to preserve their colour by sheltering them from the contact of the air: in a word, to facilitate the fusion of the colour at a low temperature not capable of destroying it.

Metallic oxides are employed sometimes directly, and merely mixed with the flux, without being previously fused with it. In many circumstances, oxides are fused previously with their flux, and afterwards ground. In speaking of colours in particular, I shall point out those which experience this kind of fusion.

I shall speak here only of the application of metallic colours to vitreous bodies or to vitreous surfaces.

These bodies may be divided into three classes, very distinct by the nature of the substances which compose them, the effects produced on them by the colours, and the changes they experience. These classes are:

1st. Enamel, soft porcelain, and all crusts, enamels, or glass, that contain lead in a notable quantity.

2nd. Hard porcelain, or porcelain which has a crust of feld-spar.

3rd. Glass, in the composition of which no lead enters, such as common window glass.

It is well known that enamel is glass rendered opaque by the oxide of tin, and exceedingly fusible by the oxide of lead. It is the oxide of lead in particular, contained in it, that gives it properties very different from those of the other excipients of metallic colours. Thus all glass and glazing that contain lead will participate in the properties of enamel; and what we shall say of one may be applied to the rest with very trifling differences. Such are the white and transparent glazing of stone ware, and the glazing of porcelain, called *soft glazing*.

This porcelain, which was the first made in France, and particularly at Sevres, where it was a long time manufactured almost exclusively, has for its base a vitreous frit, rendered almost opaque, and susceptible of being worked like clay, and is glazed with an exceedingly diaphanous glass, into the composition of which there enters a great deal of lead.

The colours employed in it are those which serve for painting in enamel; consequently, whatever changes these colours experience on enamel, they must experience on this kind of porcelain, since the causes of this change, which we shall mention hereafter, are the same.

Enamel, or soft porcelain colours, require less flux than others, because the glass on which they are applied becomes sufficiently soft to be penetrated by them. This flux may be either glass of lead and pure silex, called *rocaille*, or the same glass mixed with borax.

Montamy asserts, that glass of lead ought to be banished from among the enamel fluxes; and he employs only borax. He then dilutes his colours in a volatile oil.

On the other hand, the painters of the manufactory of Sevres, employ only colours without borax, because they dilute them in gum; and borax does not dilute well in that substance. I have found that both methods are equally good; and it is certain that Montamy was wrong to exclude fluxes of lead, since they are daily employed without any inconvenience, and as they even render the application of colours easier.

I have said that in the baking of these colours, the crust, softened by the fire, suffers itself to be easily penetrated by them. This is the first cause of the change which they experience. By mixing with the crust they become weaker, and the first heat changes a figure which appeared to be finished, into a very light sketch.

The oxide of lead which the crust contains, is a second, but much more powerful, cause of the considerable changes which colours experience. The destructive action which that metal exercises chiefly on iron reds, is singularly remarkable. I shall soon give an account of some experiments, which prove it in a very evident manner.

It has been already seen, that the two principal causes of the changes which colours on enamel and soft porcelain are susceptible of experiencing, do not depend in any manner on the composition of these colours, but on the nature of the glass to which they are applied. When it is said that the colours of porcelain change in a considerable degree, it ought to be added, that it is those of soft porcelain, a kind almost neglected.

It follows from what has been said, that painting on soft porcelain has need of being several times retouched, and of several heats, in order that it may be carried to the necessary degree of strength. These paintings have always a certain faintness; but they are constantly more brilliant, and they never are attended with the inconvenience of detaching themselves in scales.

Hard porcelain, according to the division which I have established, is the second sort of excipient of metallic colours. This porcelain, as is well known, has for its basis a very white clay, called *kaolin*, mixed with a siliceous and calcareous flux, and for its covering feld-spar fused without an atom of lead.

This porcelain, which is that of Saxony, is much newer at Sevres than the soft porcelain. The colours applied to it are of two kinds; the first, destined to represent different objects, are baked in a heat very inferior to that necessary for baking porcelain. They are exceedingly numerous and varied.

The others, destined to be fused in the same heat as that which bakes porcelain, lay themselves flat, and are much less numerous.

The colours for painting are made nearly like those destined for soft porcelain; they only contain more flux. Their flux is composed of glass of lead, *rocaille*, and borax.

When porcelain is exposed to heat, in order to bake the colours, the covering of feld-spar dilates itself and opens its pores, but does not become soft; as the colours do not penetrate it, they experience none of those changes which they undergo on soft porcelain. It must, however, be said that they lose a little of their intensity, by acquiring that transparency which is given to them by fusion.

One of the greatest inconveniences of these colours, especially in the manufactory of Sevres, is the facility with which they scale off, when exposed several times in the fire.

This inconvenience is observed more at Sevres than any where else, because it depends on the solidity and infusibility of the porcelain manufactured in that establishment. But these are qualities which make it much longer resist alternations of heat and cold, and which give to its paste a more striking whiteness. Paris porcelain, on the other hand, being more vitreous, more transparent, and bluer, and often cracks when boiling liquors are put into it.

To remedy this defect without altering the quality of the paste, I was of opinion, that the crust only ought to be softened, by introducing into it more siliceous or calcareous flux, according to the nature of the feld-spar. This method has succeeded; and for about a year past, the colours might be exposed two or three times to the fire without scaling, if not overcharged with flux, and if not laid on too thick. It has been remarked, thaw soda and potash introduced into the colours make them scale; they are, therefore, never used as fluxes. It is found that these alkalies, by becoming volatilized, abandon the colour, which, when alone, cannot form an adhesion with the crust.

The third sort of excipient of vitrifiable metallic colours, is glass without lead.

The application of these colours to glass, constitutes painting on glass; an art very much practised some centuries ago, and which was supposed to be lost, because out of fashion; but it has too direct a dependence on painting in enamel and porcelain, to be entirely lost. Besides, a description of it may be found in a very great number of works.

The limits of a memoir will not allow me to enter into historical details respecting the art of painting on glass; a full history of it has been given in the work of Leviel. The matters and fluxes which enter into the composition of the colours employed on glass, are, in general, the same as those applied to porcelain. Neither of them differ but in their proportions; but there are a great number of enamel or porcelain colours which cannot be applied to glass, where they are deprived of the white ground which serves to give them relief. When seen by refraction, several of them entirely change their tone, and assume a dirty dint, which can be of no use; we shall make them known when we come to treat of colours in particular. Those which can be employed on this body, change sometimes in baking, and acquire a great transparency. In general, they are not beautiful; but when placed between the light and the eye, they then seem to answer the only object that can be proposed in painting on glass.

The baking plates of painted glass presents more difficulties than might be supposed. Care must be taken not to disfigure the piece, or alter the colours; all the works we have read recommended a bed of gypsum. This method has sometimes succeeded; but the glass, for the most part, becomes white and full of cracks. It appears, that glass too alkaline, (and alkalies are the most common in white glass) suffers itself to be attacked when warm by the sulphuric acid of the sulphate of lime. We were able easily to bake pieces of glass much larger than those before painted, by placing them on very flat plates of earth, or of soft porcelain.

Of Colours in particular.

After collecting the general phenomena exhibited by each class of vitrifiable colours, considered in regard to the body on which they are applied, I must make known the most interesting particular phenomena, exhibited by each principal kind of colours employed on soft porcelain, and glass, in a porcelain furnace.

On Reds, Purples, and Violets, made from Gold.

Carmine red is obtained by the purple precipitate of Cassius; it is mixed with about six parts of its flux; and this mixture is employed directly, without being fused. It is then of a dirty violet, but, by baking, it acquires a beautiful red carmine colour; it is, however, exceedingly delicate; a little too much heat, and carbonaceous vapours, easily spoil it. On this account it is more beautiful when baked with charcoal than with wood.

This colour, and the purple, which is very little different, as well as all the shades obtained from it, by mixing it with other colours, really change on all porcelain, and in every hand. But it is the only one that changes on hard porcelain. Its place may be supplied by a rose colour from iron, which does not change, so that by suppressing the carmine made with gold, and substituting for it the rose oxide of iron, here alluded to, you may exhibit a palette composed of colours, none of which change in a remarkable manner. This rose-coloured oxide of iron has been long known; but it was not employed on enamel, because on that substance it changes too much. As the painters on enamel, however, have become the painters on porcelain, they have preserved their ancient method.

It might be believed, that by first reducing to a vitreous matter the colour called *carmine*, already mixed with its flux, it might be made to assume its last tint. But the heat necessary to fuse this vitreous mass destroys the red colour, as I have experienced. Besides, it is remarked, that to obtain this colour very beautiful it must be exposed to the fire as few times as possible.

Red, Rose, and Brown Colours extracted from Iron.

These colours are made from the red oxide of iron, prepared with nitric acid. These oxides are further calcined, by keeping them exposed to the action of heat. If heated too much they pass to brown.

Their flux is composed of borax, sand, and minium, in small quantity.

These oxides give rose and red colours, capable of supplying the place of the same colours made with oxide of gold. When properly employed on hard porcelain, they do not change at all. I have caused roses to be painted with these colours, and found no difference between the baked flower and that not baked, except what might be expected to result from the brilliancy given to colours by fusion.

These colours may be employed indiscriminately, either previously fused or not fused.

The composition of them is the same both for soft porcelain and for glass; they do not change on the latter, but on soft porcelain they disappear almost entirely on the first exposure to heat, and to make any thing remain they must be employed very deep.

This singular effect must be ascribed to the presence of lead in the crust or glazing. I assured myself of this by a very simple experiment: I placed this colour on window-glass, and having exposed it to a strong baking, it did not change.

Yellows.

Yellows are colours which require a great deal of care in the fabrication, on account of the lead which they contain, and which approaching sometimes to the metallic state, produces on them black spots.

The yellows for hard and soft porcelain are the same: they are composed of the oxide of lead, white oxide of antimony, and sand.

Oxide of tin is sometimes mixed with them, and when it is required to have them livelier, and nearer the colour *du souci*, red oxide of iron is added, the too great redness of which is dissipated in the previous fusion to which they are exposed by the action of the lead contained in this yellow. These colours when once made never change: they disappear, however, almost entirely when exposed to a porcelain heat.

These yellows cannot be applied to glass, they are too opaque and dirty; that employed by the old painters on glass has, on the contrary, a beautiful transparency, is exceedingly brilliant, and of a colour which approaches near to that of gold. The processes which they gave, clearly showed that silver formed part of their composition; but, when exactly followed, nothing satisfactory was obtained. C. Miraud has found means to make as beautiful paintings on glass as the ancients, by employing muriate of silver, of zinc, white argil, and yellow oxide of iron. These colours are applied on glass merely pounded, and without a flux. The oxide of iron brings the yellow to that colour which it ought to have after baking, and contributes with the argil and oxide of zinc, to decompose the muriate of silver, without deoxidating the silver. After the baking, there remains a dust which has not penetrated into the glass, and which is easily removed.

This yellow, when employed thicker, gives darker shades, and produces a russet.

Blues.

It is well known, that these are obtained from the oxide of cobalt. All chymists are acquainted with the preparation of them. Those of Sevres, which are justly esteemed for their beauty, are indebted for it only to the care employed in manufacturing them, and to the quality of the porcelain, which appears more proper for receiving them in proportion to the degree of heat it can bear.

The blue of hard porcelain, destined for what is called the ground for a great heat *(les fonds au grand feu)*, is fused with feld-spar; that of soft porcelain has for its flux, silex, potash, and lead; it is not volatilized like the preceding, but the heat it experiences is very inferior to that of hard porcelain.

These colours, when previously fused, do not change at all in the application.

Blues on glass exhibit the same phenomena as those on soft porcelain.

Greens.

The greens employed in painting are made with green oxide of copper, or sometimes with a mixture of yellow and blue. They must be previously fused with their flux, otherwise they will become black; but after this first fusion they no longer change.

They cannot stand a strong heat, as it would make them disappear entirely. Green grounds for a strong heat are composed with the oxides of cobalt and nickel, but a brownish green only is obtained.

Bluish greens, called *celestial blues*, which were formerly colours very much in vogue, can be applied only upon soft porcelain; on hard porcelain they constantly become scaly, because potash enters into their composition.

These greens cannot be applied on glass, they give a dirty colour. To obtain a green on glass it is necessary to put yellow on one side, and blue, more or less pale, on the other. This colour may be made also by a mixture of blue, with yellow oxide of iron. I hope to obtain from oxide of chrome a direct green colour: the trials I have made give me reason to hope for success. Pure chromate of lead, which I applied to porcelain in a strong heat, gave me a beautiful green of great intensity, and very fixed.

Bistres and Russets.

These are obtained by mixtures in different proportions of manganese, brown oxide of copper, and oxide of iron from ombre earth; they are also previously fused with their flux, so that they do not change in any manner on soft porcelain.

This colour fades very speedily on glass.

Russet grounds in a great heat, known under the name of *tortoiseshell grounds*, are made in the same manner. Their flux is feldspar.

Blacks.

Blacks are the colours most difficult to be obtained very beautiful. No metallic oxide gives alone a beautiful black, manganese is that which approaches nearest to it. Iron gives an opaque, dull, cloudy black, which changes very easily to red; the colour makers, therefore, to obtain a black which they could not hope for from the best theorist, have united several metallic oxides, which separately do not give black, and have obtained a very beautiful colour, which, however, is likely to become scaly and dull.

These oxides are those of manganese, the brown oxides of copper, and a little of the oxide of cobalt; the grey is obtained by suppressing the copper, and increasing the dose of the flux.

Having here made known the principles of the fabrication of each principal colour, it may be readily conceived, that by mixing these colours together, all the shades possible may be obtained. It is evident, also, that care in the preparation, choice in the raw materials, and a just proportion of doses, must produce in the results, differences very sensible to an eye accustomed to painting. A mere knowledge of the composition of colours, does not give the talent of executing them well.

In recapitulating the facts above mentioned, to present them under another general point of view, it is seen;

1st. That among colours generally employed upon hard porcelain, one only is susceptible of changing, viz., carmine from gold, and the tints into which it enters; that its place may be supplied by the reds of iron, and that no colour then changes.

2nd. That among the colours for soft porcelain and enamel, several change in a considerable degree. These are principally the reds of gold and iron, the yellows, the greens, the browns; they have not been replaced by others, because this kind of painting has been almost abandoned.

3d. That several of the colours on glass change also by acquiring complete transparency. These in particular are the yellows and greens.

4th. That it is neither by calcining the colours in a higher degree, nor previously fusing them, as supposed by some, that they are prevented from changing, since these means really alter the changing colours, and produce no effect on the rest. The change which several colours experience on soft porcelain and on glass does not then depend on the nature of their composition, but rather on that of the body on which they are applied.

Consequently, by suppressing from the colours of hard porcelain the carmine of gold, which is not indispensably necessary, we shall have a series of colours which do not change.

LXXX.—On the Rumford Premium of the American Academy.

From the *Boston Journal of Science* for 1824, we copy the account of the donation of Count Rumford, and the purposes of the gift. Upwards of thirty years have elapsed, yet the prize has never been awarded to any one, and the interest of the fund now amounts biennally to upwards of two thousand dollars. Is the existence of the premium nearly unknown, or have thirty years passed without any important discovery or useful improvement having been made on heat or light in the American continent or islands? We really think that were the Count now alive, he would be able to designate persons fully entitled to the reward.—Editor.

In the year 1796, Count Rumford, then residing in London, presented to the American Academy of Arts and Sciences, five thousand dollars, in three per cent. stock, for the purpose of establishing a biennial premium to be awarded to the author of the most important discovery, or most useful improvement on heat or light, which should be made in any part of America. The following letter, addressed to the president of the academy, accompanied the donation, and contains an account of the views of the liberal donor, and of the terms upon which the premium was to be awarded.

To the Hon. John Adams, President of the American Academy of Arts and Sciences.

Sir,—Desirous of contributing efficaciously to the advancement of a science which has long employed my attention, and which appears to me to be of the highest importance to mankind, and wishing at the same time to leave a lasting testimony of my respect for the American Academy of Arts and Sciences, I take the liberty to request that the Academy would do me the honour to accept of five thousand dollars, three per cent. stock, in the funds of the United

States of North America, which stock I have actually purchased, and which I beg leave to tranfer to the Fellows of the Academy, to the end that the interest of the same may be by them and by their successors received from time to time for ever, and the amount of the same applied and given once every second year as a premium, to the author of the most important discovery or useful improvement, which shall be made and published by printing, or in any way made known to the public in any part of the continent of America, or in any of the American islands, during the preceding two years, on heat or on light; the preference always being given to such discoveries as shall, in the opinion of the Academy, tend most to promote the good of mankind.

With regard to the formalities to be observed by the Academy in their decisions upon the comparative merits of those discoveries which, in the opinion of the Academy, may entitle their authors to be considered as competitors for this biennial premium, the Academy will be pleased to adopt such regulations as they, in their wisdom, may judge to be proper and necessary. But in regard to the form in which this premium is conferred, I take the liberty to request that it may always be given in two medals, struck in the same die, the one of gold, and the other of silver, and of such dimensions that both of them together may be just equal, in intrinsic value, to the amount of the interest of the aforesaid five thousand dollars' stock during two years; that is to say, that they may together be of the value of three hundred dollars.

The Academy will be pleased to order such device or inscription to be engraved on the die they shall cause to be prepared for striking these medals, as they may judge proper.

If, during any term of two years, reckoning from the last adjudication, or from the last period for the adjudication of this premium by the Academy, no new discovery or improvement should be made in any part of America relative to either of the subjects of question (heat or light), which in the opinion of the Academy shall be of sufficient importance to deserve this premium; in that case, it is my desire that the premium may not be given, but that the value of it may be reserved, and being laid out in the purchase of additional stock in the American funds, may be employed to augment the capital of this premium; and that the interest of the sums by which the capital may from time to time be so augmented, may regularly be given in money, with the two medals, and as an addition to the original premium, at each succeeding adjudication of it. And it is further my particular request, that those additions to the value of the premium, arising from its occasional non-adjudications, may be suffered to increase without limitation.

With the highest respect for the American Academy of Arts and Sciences, and the most earnest wishes for their success in their labours for the good of mankind. I have the honour to be, with much esteem and regard, sir,

Your most obedient, humble servant,

London, July 12, 1796. RUMFORD.

Upon the receipt of the donation, the thanks of the Society were presented to Count Rumford in the following terms:—

Voted, That the thanks of the Academy be presented to Count Rumford, for this his very generous donation, and that they experience the highest satisfaction in receiving this additional and very liberal aid for the encouragement and extension of those interesting branches of science which he has specified as the objects of his gratuity, and which *he* has so successfully cultivated. That they entertain a high sense of the sentiments and views, so becoming a philosopher, which have prompted him to this distinguished act of liberality; and in the execution of the grateful office which they have undertaken, of awarding and distributing the premium which Count Rumford has thus appropriated, they will sacredly comply with the conditions of the donation; indulging the hope that he will meet his reward, in learning that many in his native country are thereby excited to emulate his labours, and to promote the accomplishment of his beneficent wishes, for the advancement of science, and the augmentation of human happiness.

At a meeting held in May, 1801, the Society voted that they would, at their meeting in May of the next year, and afterwards biennially at their May meeting, decide upon the discovery or improvement which appeared to deserve the Rumford premium. The subject, we believe, has frequently been brought before the Society, and they have been ready at the appointed time to confer the premium upon any individual whose claims were sufficient to authorize it. No discovery, however, or improvement has yet been made which has been deemed worthy this honour, and the fund has of course been accumulating, according to the terms of the donation, ever since it has been in the hands of the Society.

At the present time the fund amounts to 7,361*l.* 19*s.* in six per cent., and 7,050*l.* in 7 per cent. stocks. The premium awarded would, therefore, be the interest of these sums for two years; three hundred dollars in the form of a silver and a gold medal, and the residue in money. This, we believe, is one of the largest premiums offered by any society or institution for discoveries in science or improvements in the arts, and is well worthy the attention of the scientific and ingenious men of our country.

The next meeting of the Society will be held on Tuesday, the 25th of May next, at their room in the Boston Atheneum. At this meeting the Society will be ready to decide upon any claims which may be offered for the premium in question, it being the regular biennial period at which, by their vote of 1801, this subject comes before them.

LIST OF PATENTS FOR NEW INVENTIONS,

Which have passed the Great Seal since April 26, 1828.

To William Marshall, of Fountain Grove, in the parish of Huddersfield, in the county of York, shear manufacturer; for improvements in machinery for cutting or shearing, cropping and finishing, cloth, and other articles manufactured from wool, or other raw materials. Dated April 26, 1828.—To be specified in two months.

To Thomas Breidenbach, of Birmingham, in the county of Warwick, merchant; for a machine, or improved mode by use of machinery, for forging or manufacturing tubes or rods, and for other purposes. Dated April 26, 1828.—In four months.

To James Griffin, of Witley Moor Works, near Dudley, in the county of Worcester, scythe manufacturer; for an improvement in the manufacturing of scythe backs, chaff knife backs, and hay knife backs. Dated April 26, 1828.—In six months.

To John James Watt, of Stacy-street, Stepney, in the county of Middlesex, surgeon; for the application of a certain chemical agent by which animal poison may be destroyed, and the disease consequent thereon effectually prevented. Dated April 29, 1828.—In six months.

To Charles Carpenter Bompas, of the Inner Temple, Esq.; for improvements in the propelling of locomotive carriages and machines, and boats and other vessels. Dated April 29, 1828.—In six months.

To Thomas Hillman, of Millwall, Poplar, in the county of Middlesex, mast maker; for certain improvements in the construction and fastening of made masts. Dated May 1, 1828.—In six months.

To Jonathan Brownill, of Sheffield, in the county of York, cutler; for an improved method of transferring vessels from a higher to a lower level, or from a lower to a higher level, on canals; also for the more conveniently raising or lowering of weights, carriages, or goods on rail roads, and for other purposes. Dated May 1, 1828.—In six months.

To James Palmer, of Globe-road, Mile End, in the county of Middlesex, paper maker; for certain improvements in the moulds, machinery, or apparatus for making paper. Dated May 6, 1828.—In six months.

To Thomas Adams, of Oldbury, in the county of Salop, manufacturer; for certain improvements on instruments, trusses, or apparatus for the relief or cure of hermia or rupture. Dated May 6, 1828.—In six months.

To Francis Westby, of Leicester, cutler; for certain improved apparatus to be used for the purpose of whetting or sharpening the edges of the blades of knives, or other cutting instruments. Dated May 6, 1828.—In two Months.

To Samuel Brooking, Esq., of Plymouth, in the county of Devon, a rear admiral in our royal navy; for a certain turning or shipping fid, for securing and releasing the upper masts of ships and vessels. Dated May 6, 1828.—In six months.

To Matthew Fullwood, Jun., of Stratford, in the county of Essex, gent.; for a cement, mastic, or composition, which he intends to denominate, "German Cement." Dated May 6, 1828.—In two months.

To John Benjamin Macniel, of Foleshill, Coventry, engineer; for certain improvements in preparing and applying materials for the making, constructing, or rendering more durable, roads and other ways; which materials so prepared are applicable to other purposes. Dated May 6, 1828.—In six months.

To Thomas Jackson, of Red Lion-street, Holborn, in the county of Middlesex, watch maker; for a new metal stud, to be applied to boots and shoes, and other like articles of manufacture. Dated May 13, 1828.—In six months.

To John Ford, of Wandsworth-road, Vauxhall, in the county of Surrey, machine maker; for certain improvements in machinery for cleaning, opening, scribbling, carding, combing, slabbing, and spinning wool; and for carding and roving, or slivering and spinning, cotton, short stapled flax, hemp, and silk, either separately or combined; and for spinning or twisting long stapled flax, hemp, silk, mohair, or other fibrous substances, and either separately or combined. Dated May 13, 1828.—In six months.

To Thomas Bonsor Crompton, of Tamworth, in the county of Stafford, paper makar; and Enoch Taylor, of Marsden, in Yorkshire, millwright; for certain improvements in that part of the process of paper making which relates to the cutting. Dated May 13, 1828.—In two months.

To Charles Chubb, of St. Paul's Church-yard, in the city of London, patent lock manufacturer; for certain improvements in the construction of latches, which may be used for fastening doors or gates. Dated May 17, 1828.—In six months.

To Thomas, William, and John Powell, of the city of Bristol, glass merchants and stone-ware manufacturers; for certain improvements in the process, machinery, or apparatus for forming, making, or producing moulds, or vessels, for refining sugar; and in the application of materials hitherto unused in making the said moulds. Dated May 17, 1828.—In two months.

END OF THE SECOND VOLUME.

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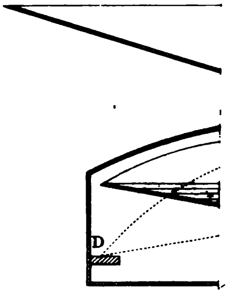

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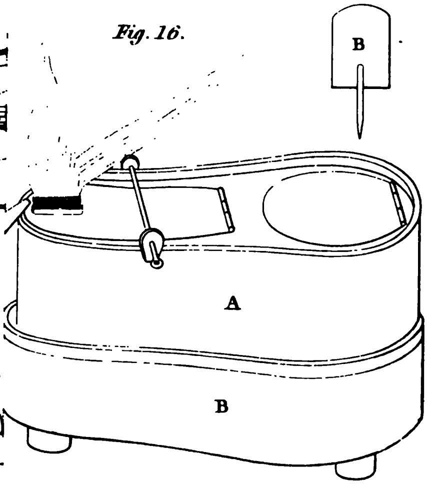

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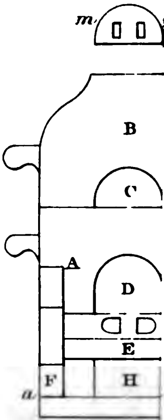

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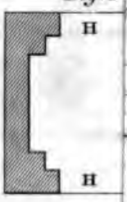

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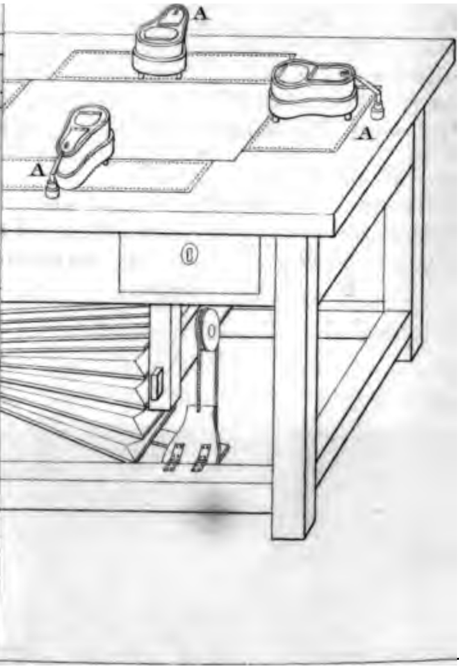

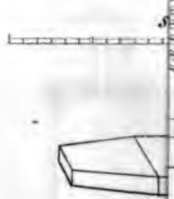

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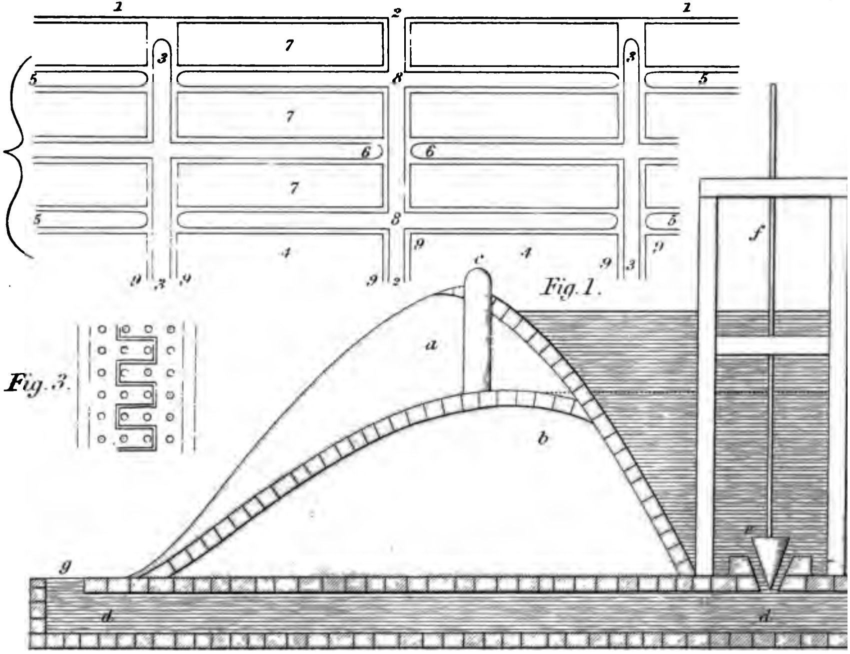

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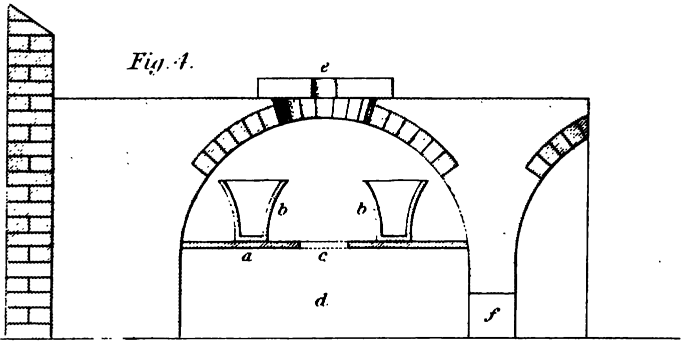

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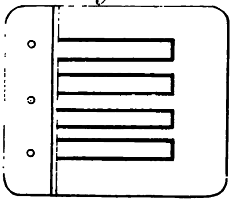

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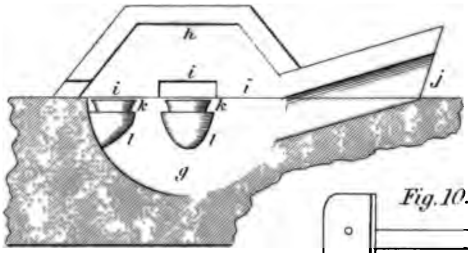

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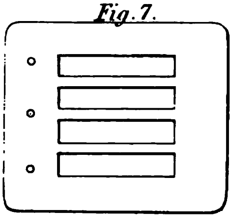

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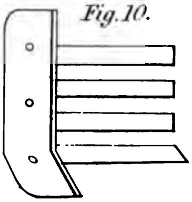

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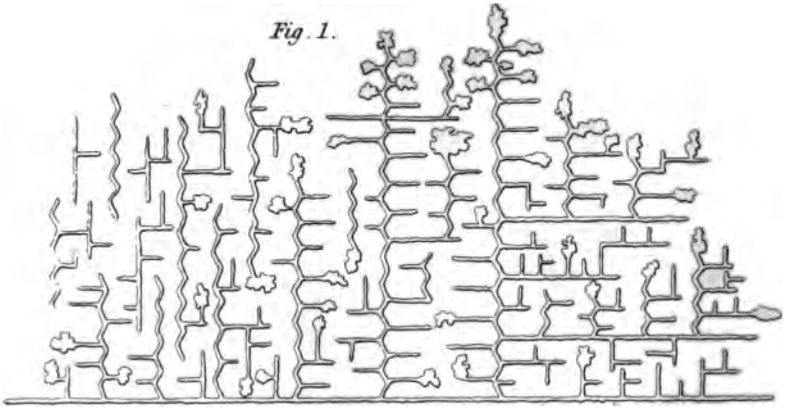

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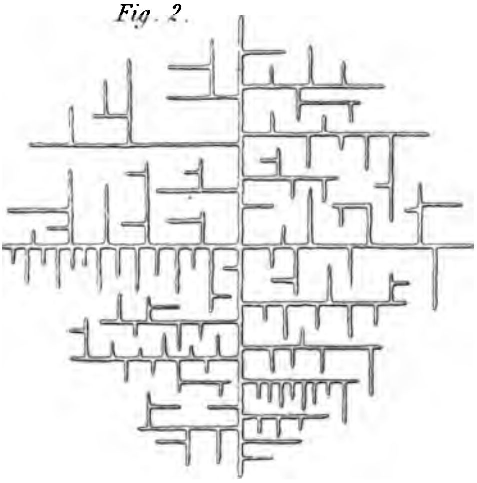

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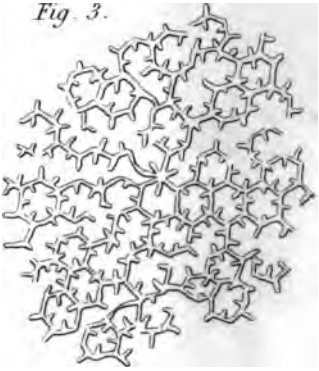

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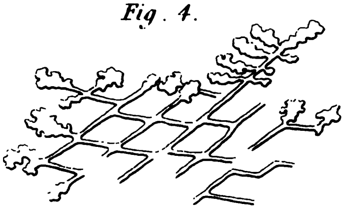

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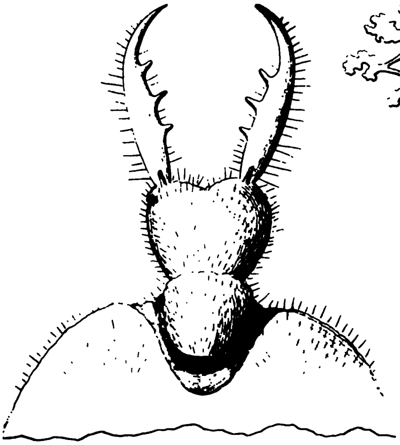

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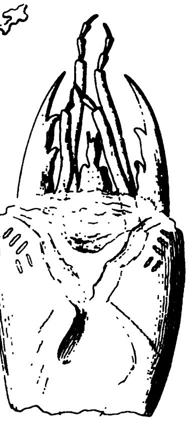

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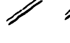

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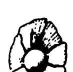

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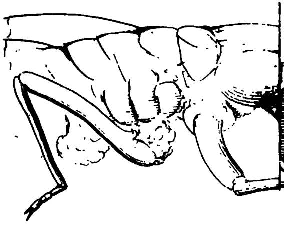

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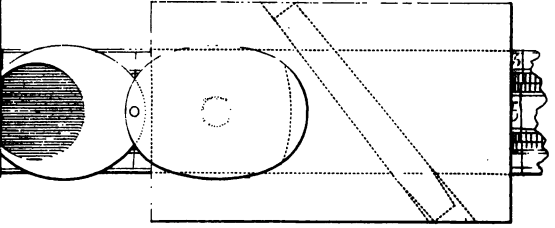

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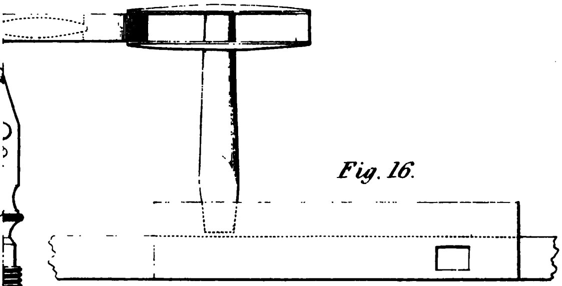

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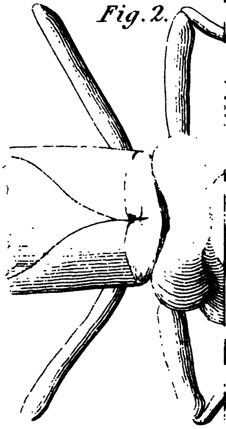

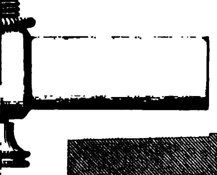

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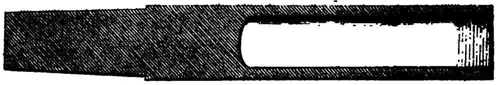

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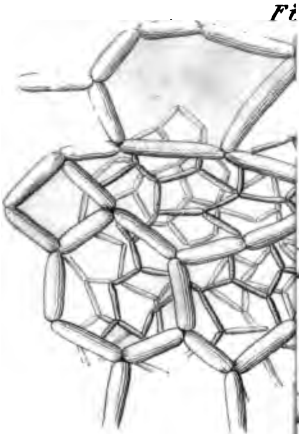

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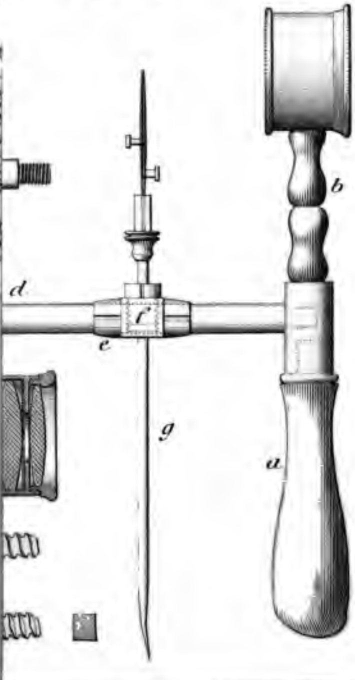

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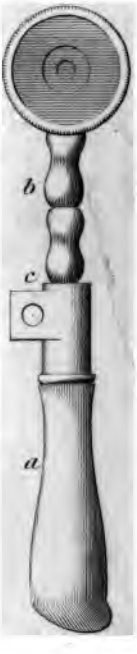

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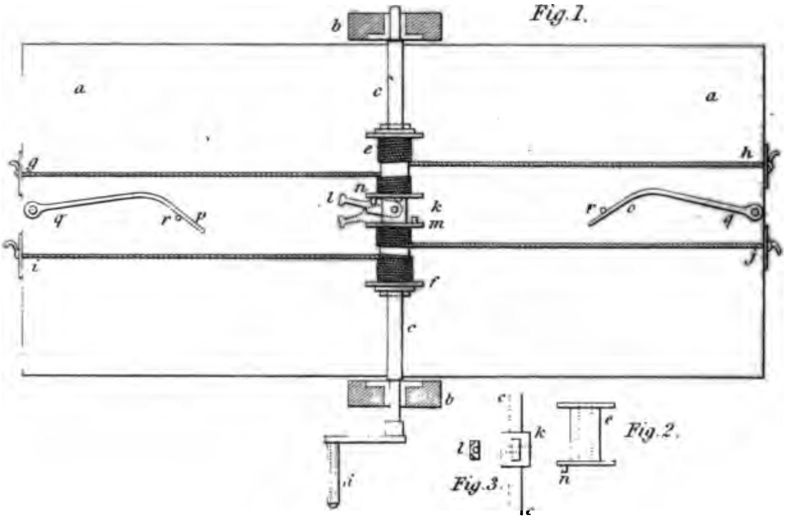

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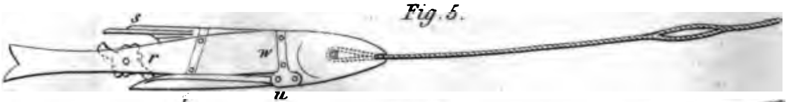

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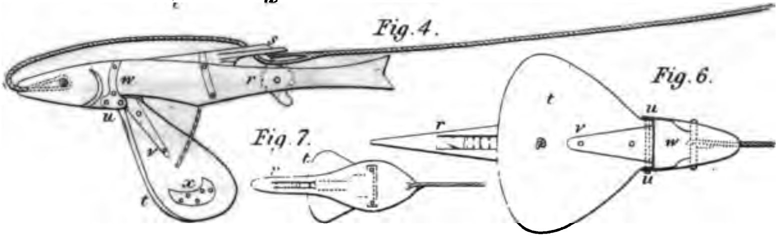

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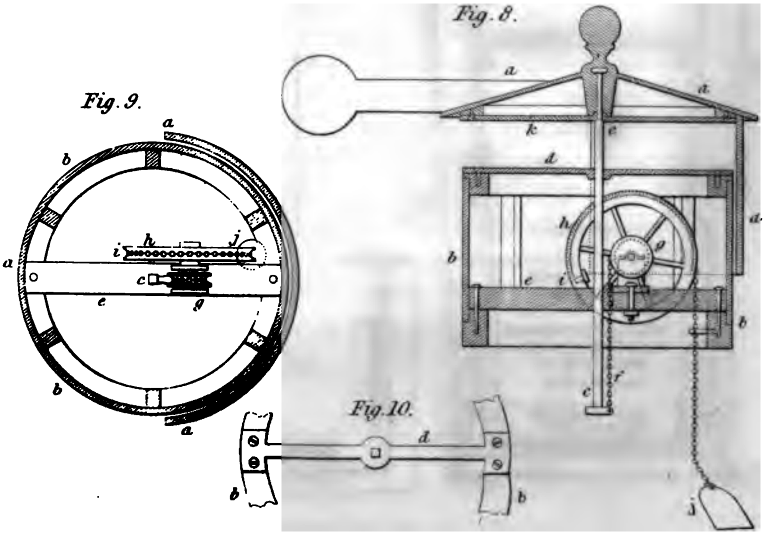

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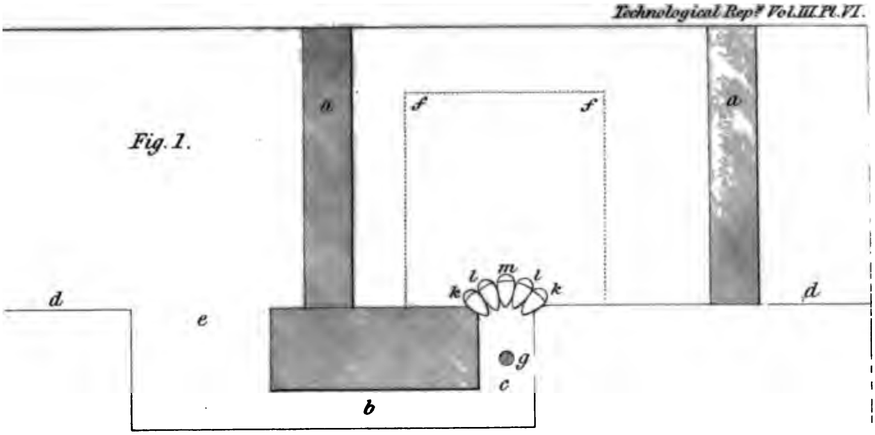

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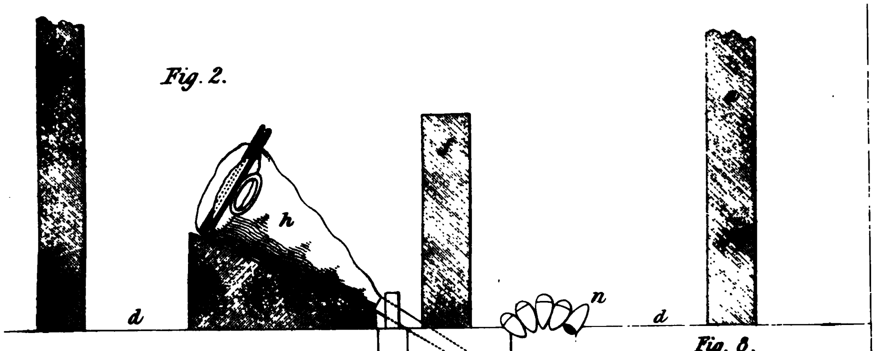

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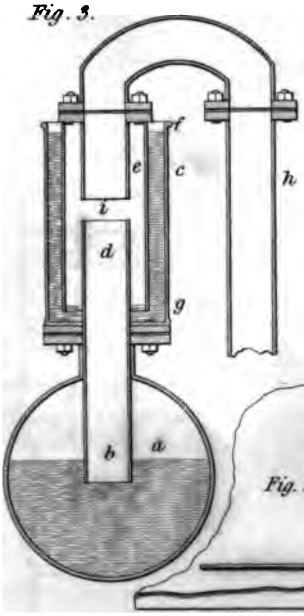

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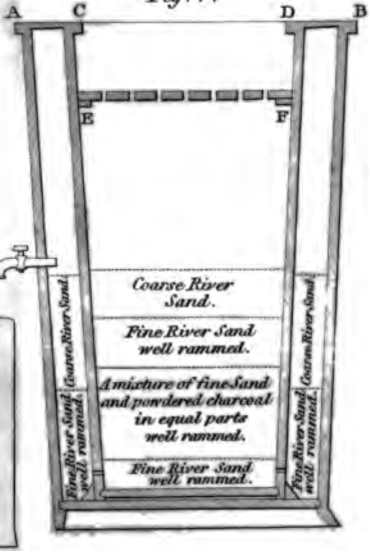
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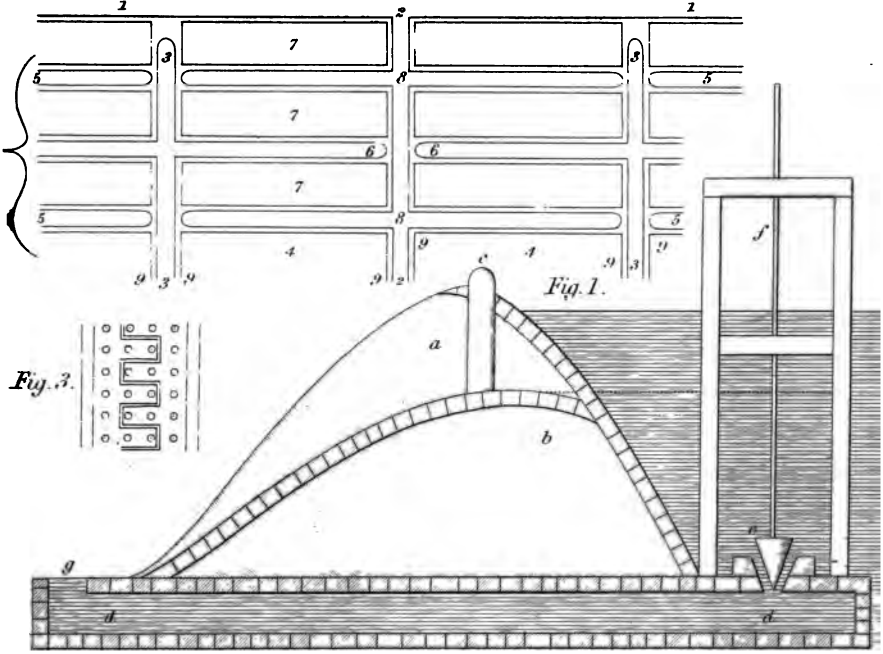

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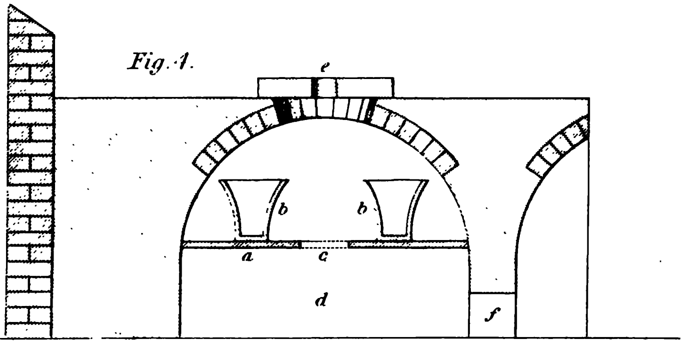

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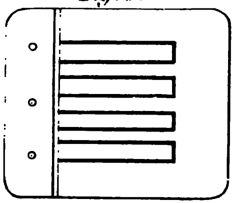

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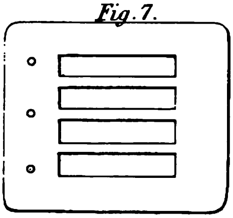

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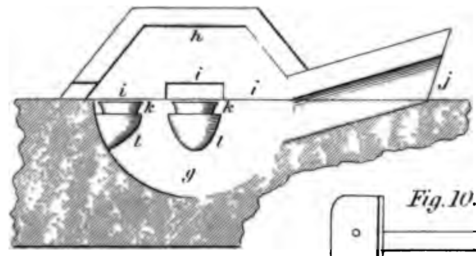

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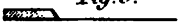

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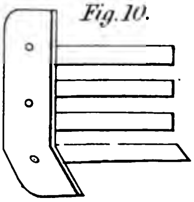

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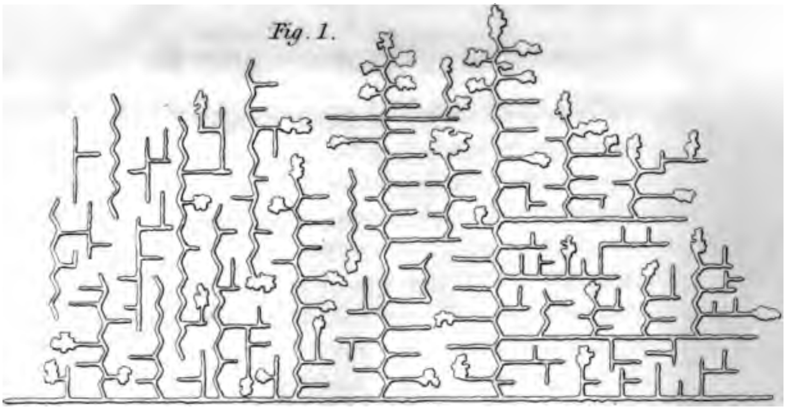

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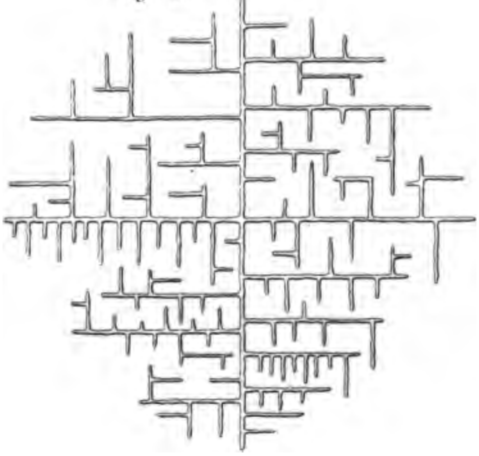

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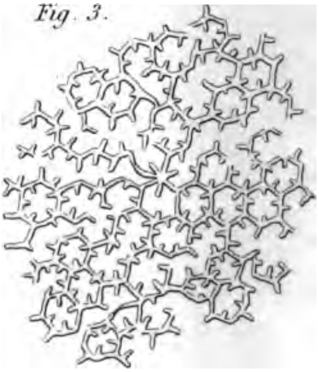

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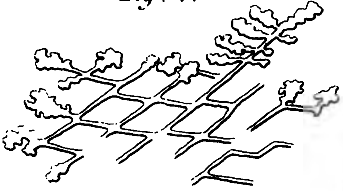

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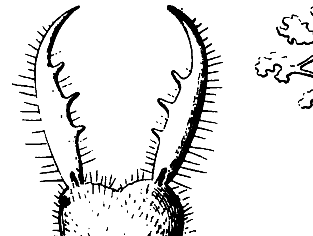

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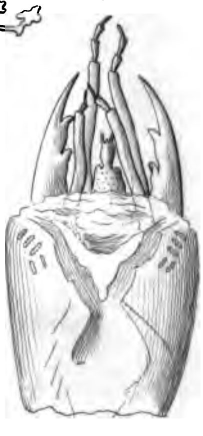

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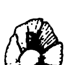

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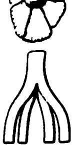

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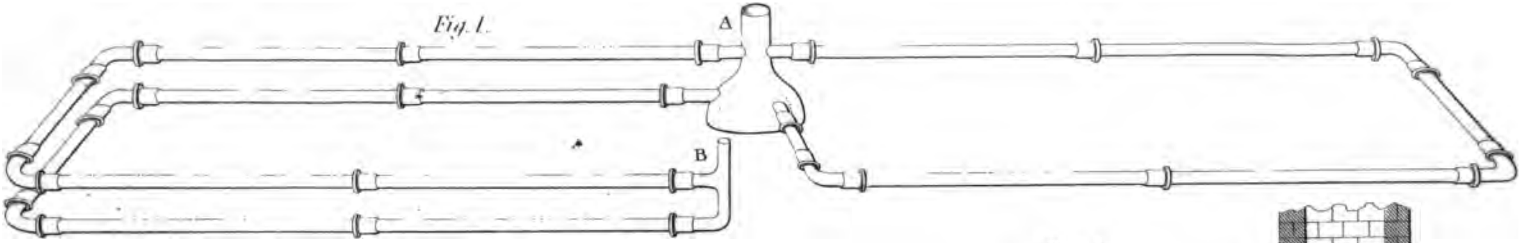

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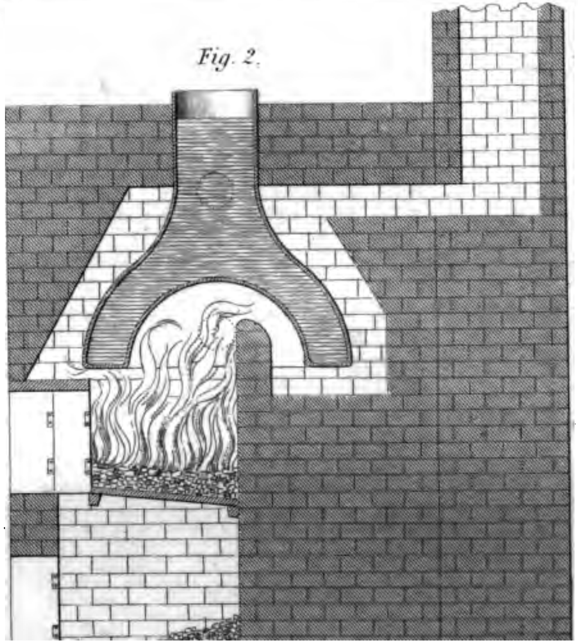

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